THE FOUNDRY

A Monthly Journal for all Departments of the Foundry Business

Vol. 40, No. 5 Cleveland, Ohio, May 1912 Whole No. 237

Latest Development of the Permanent Mold

Construction and Methods of Operating Wonderfully Ingenious Machines for Casting Small Projectiles and Grate Bars in Gray Iron

WHEN the permanent mold for gray iron castings was first conceived a number of years ago, it was claimed that its limitations would be determined by the shape of the section and, while it was admitted that the practice might prove successful, nevertheless the fact that it lacked universal application, to an extent, minimized its importance. It was not believed that it would be possible to produce castings such as soil pipe fittings in permanent molds, owing to the large area that had to be cored out, and while it was generally agreed that it might be applicable to sash weights, brake shoes and other heavy sections, many foundrymen trained in the casting of iron in sand had to be shown when informed of the results which have made history in the foundry world in recent years. The equipment for producing pipe fittings in permanent molds was fully described in the columns of THE FOUNDRY several years ago, and since that time numerous other machines have been built for casting intricate gray iron sections, which are in successful use today. The section or rather the form of the casting no longer seems to be the obstacle that retards the widespread application of the permanent mold. The ingenuity of the builders in designing molds for various intricate castings, if taken as a basis for future development, might result in the prediction that there are few sec-

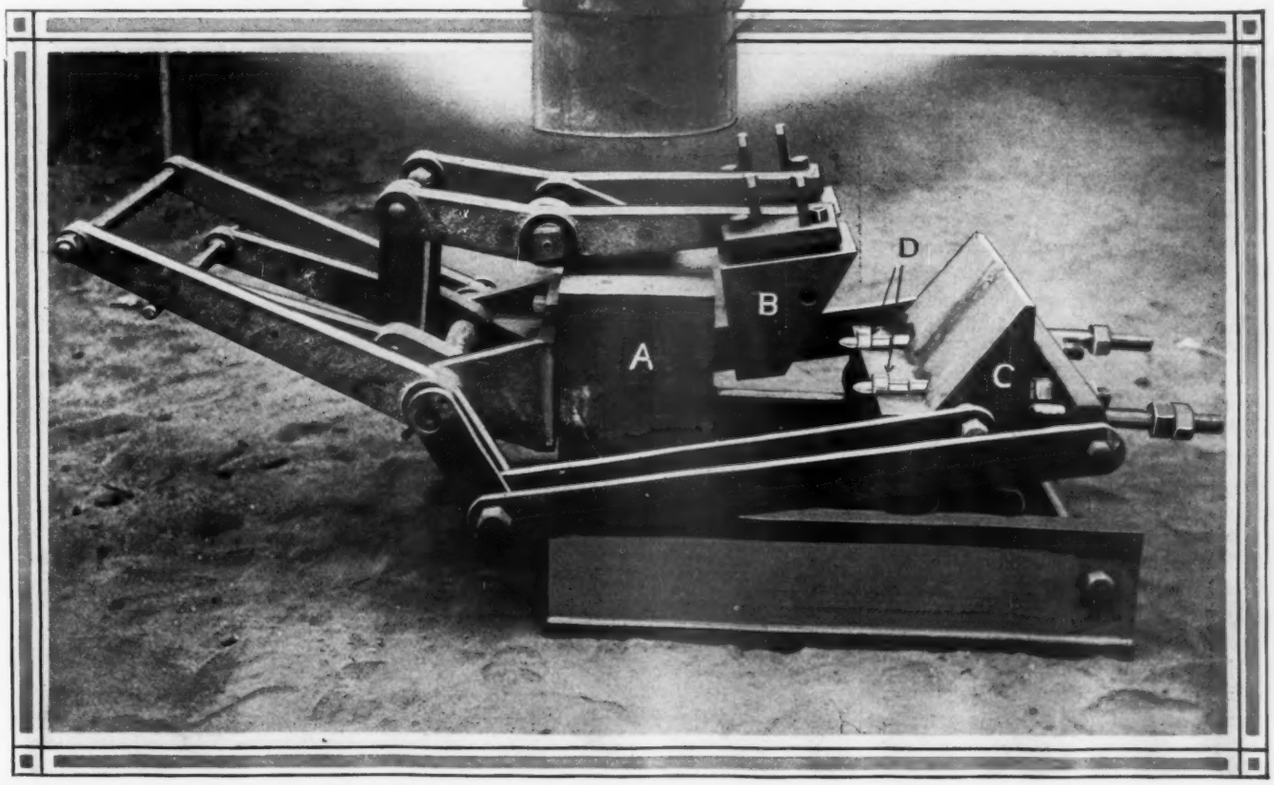


FIG. 1—PERMANENT MOLD FOR CASTING TWO PROJECTILES AT ONE TIME; ONE OF THE PROJECTILES, AS CAST, IS SHOWN AT THE TOP OF THIS ILLUSTRATION

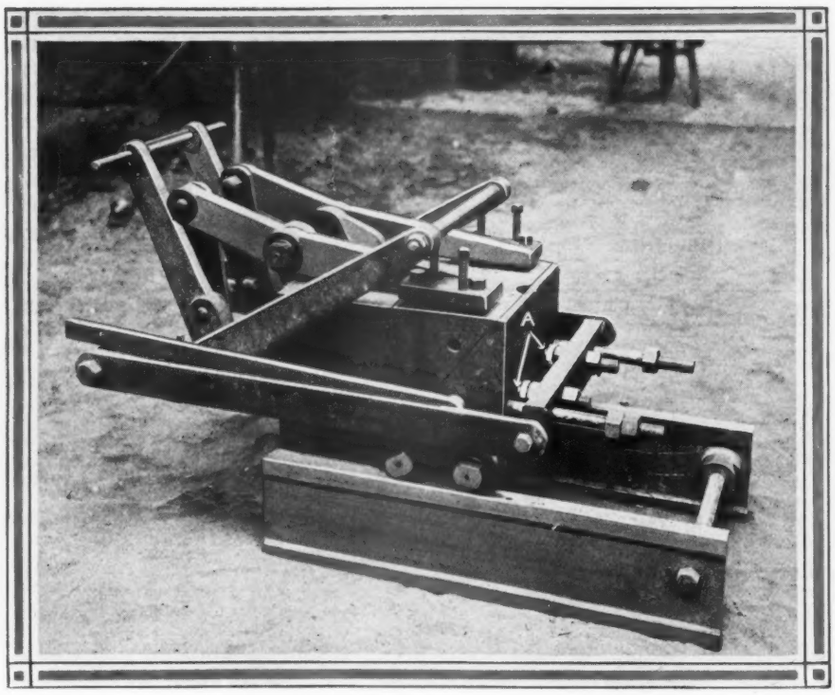


FIG. 2—THE PERMANENT MOLD FOR CASTING PROJECTILES, IN CLOSED POSITION FOR RECEIVING THE METAL

tions, either gray iron or steel, which cannot be successfully made in cast iron molds. To the untiring persistence of Edgar Allen Custer of the Custer Sandless Casting Co., Philadelphia, the great development in permanent mold practice for gray iron is almost entirely due. Not many years ago, at the plant of the Tacony Iron Co., Tacony, Pa., Mr. Custer installed a continuous soil pipe casting machine employing heavy permanent molds and sand cores. The next development led to the installation of a battery of machines for making soil pipe fittings of all sizes in which cast iron cores were successfully used. Sash weights were next attacked and this problem proved easy of solution. Permanent molds were then successfully made for plow points and agricultural castings of all kinds, brake shoes, etc.

The design and construction of the permanent molds was by no means the only feature of this practice which required careful investigation. The melting of the iron, the shaking-out of the castings and the temperature of the iron when poured were among the few problems which had to be solved before success crowned the efforts of the investigators in this line of work. Mr. Custer has freely given to the foundry world the results of his experiences, and the methods of melting, casting, etc., pursued in permanent mold practice, have formed the basis for numerous articles which have appeared in THE FOUNDRY from time to time during the past four years.

An exceedingly ingenious machine which has been installed in the foundry of the League Island navy yard, Philadelphia, was designed to cast at one time, two 1 pound projectiles for use in United States navy target practice service. This permanent mold, which is shown in Figs 1, 2, 3 and 4, embodies several novel features. A copper ring or band is cast in place around the shell, a portion of the casting is hardened and, in addition, air-hardened steel cores are employed. As illustrated in Fig. 1, the mold is made in three parts, a fixed block, *A*, and two movable blocks, *B* and *C*. Attached to the fixed block are the lever brackets which serve as the fulcrum for the various motions of the levers which are arranged to perform four different functions with one motion of the main lever. In Fig. 2 the mold is shown closed ready to pour. Both movable parts of the permanent mold have been locked in position. The lower part of the mold, *C*, Fig. 1, has been locked by two straight clamps pinned to this mold section and notched over the shaft in the rear, while the upper part of the mold, *B*, Fig. 1, has been locked by the toggle levers which are adjusted to form a straight line as indicated in Fig. 2.

Drawing the Cores

The first movement of the lever has as its function the drawing of the cores from the castings. This movement can readily be noted by comparing Figs. 2 and 3. It will be seen that at *A*, Fig. 2, the adjusting nuts are practically flush with the face of the pattern, while at *A*, Fig 3, the levers have moved forward the bars carrying the air-hardened steel cores, thereby withdrawing them from the castings. The next function of the levers is to release the clamps on the lower block, *C*, Fig. 1. This is

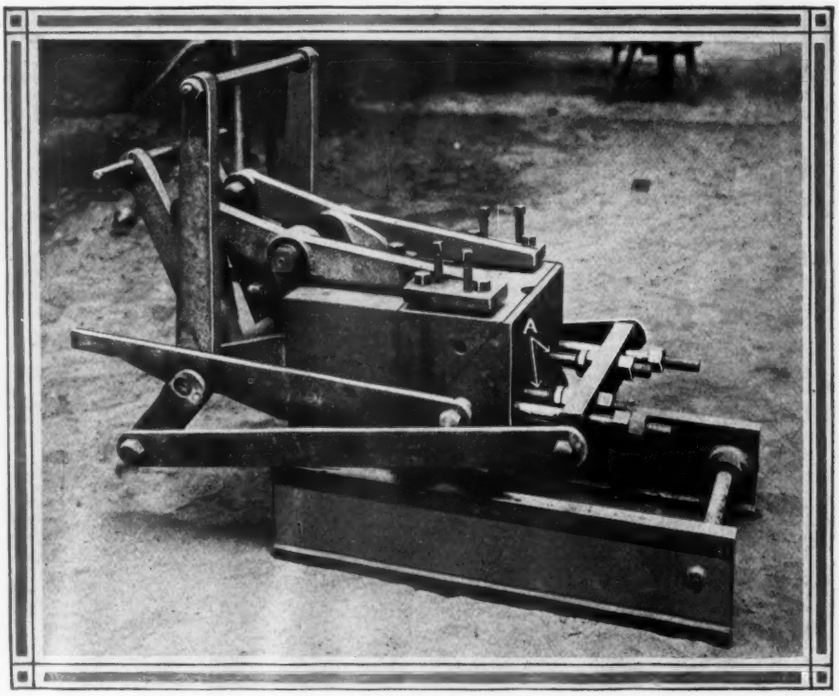


FIG. 3—PERMANENT MOLD FOR CASTING PROJECTILES, SHOWING THE FIRST OPERATION OF THE LEVERS WHICH WITHDRAW THE CORES FROM THE CASTINGS

accomplished by means of two small pins, one on either side of the main lever, which, as the lever moves around, engage the clamps and throw them up out of their notches. Fig. 3 shows the pins about to engage the clamps. As the lever continues its movement, the moving plate to which the cores are attached comes in contact with the lock nuts on the studs and carries back the lower block or part *C*, Fig. 1, on its rollers. As it reaches a position where it is clear of the casting, the lever engages the toggle lever and, breaking the straight line of the links, raises the upper movable piece, *B*, Fig. 1.

Operating Movements

The separate motions and the timing of the movements of these blocks have been designed to produce a casting soft on the portion to be machined and hardened on the point. The first motion draws the cores, leaving the interior of the projectile soft and machinable. The clamps being released next, the lower portion of the mold is moved clear of the casting, as illustrated in Fig. 1, while the upper portion holds the castings in the fixed part of the mold, *A*. Finally, the upper portion, *B*, Fig. 1, frees itself from the castings, leaving them held by their points in part *A* of the permanent mold. A view of the mold with the upper portion raised away from the castings is illustrated in Fig. 4. This final operation must, of necessity, occur before the castings have reached their chilling point, as otherwise the shells would not be machinable. The complete operation of opening the mold requires only about two seconds. After the mold is open the castings are left for a few seconds with their points in the fixed portion, while they take the required degree of hardness and then are removed by means of tongs. The copper rings, cut from seamless drawn tubing, are set in the mold before closing, as indicated at *D*, Figs. 1 and 4. It will be noted in Fig. 1 that the cores pass directly through these copper rings which become firmly seated on the cast projectiles. The cores are made of air-hardened tool steel which has been found to be well-adapted for this work, as it does not swell, warp or cut under the conditions of temperature which obtain in this mold. The gates are cut in the movable portions of the permanent mold and are clearly indicated in Figs. 1 and 4. The standing gate is in the lower portion of the mold, *C*, Fig. 1, and the running gate is in the upper portion of the mold, *B*, Fig. 4, to give the necessary clearance.

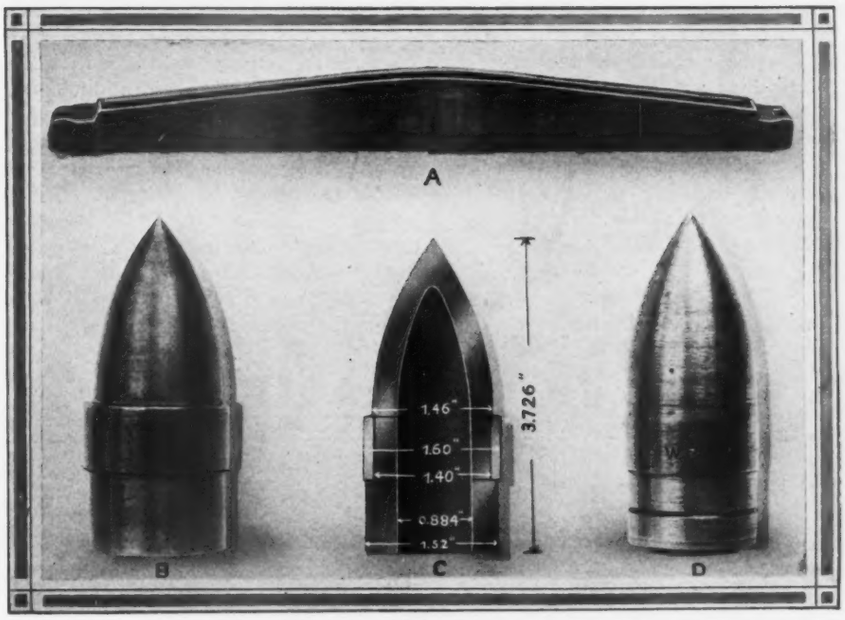


FIG. 5—A GRATE BAR MADE IN A PERMANENT MOLD IS SHOWN AT *A*; *B* AND *D* SHOW THE PERMANENT MOLD PROJECTILE AND *C* IS A SECTIONAL VIEW, GIVING DIMENSIONS

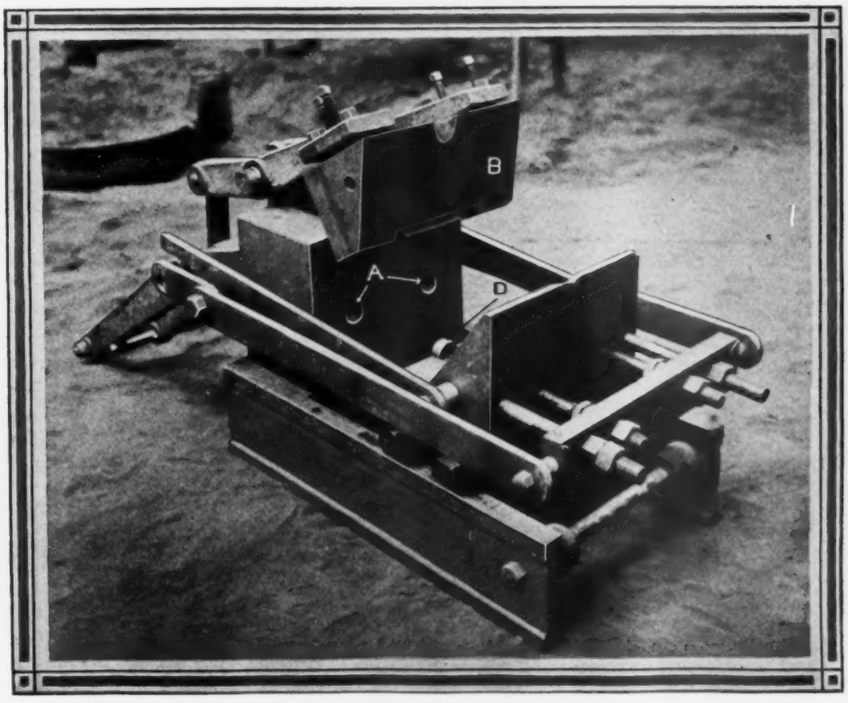


FIG. 4—PROJECTILE MOLD OPEN, SHOWING FACE OF STATIONARY SECTION OF MOLD; *A* INDICATES THE OPENINGS IN WHICH THE UPPER PORTION OF THE PROJECTILE IS CAST AND REMAINS FOR A BRIEF PERIOD TO BE HARDENED

Time of Operation

The entire operation of pouring, opening the mold and removing the castings requires about 10 seconds and the mold can be poured as rapidly as it can be cleaned out, the copper rings placed in position and the mold closed. There is no finish on this casting from the copper ring to the point, as this portion is cast to within a few thousandths of an inch of the required size. The copper ring is finished to fit the rifling of the gun barrel and the portion of the casting back of the ring is turned and grooved for the cartridge shell. The hole is threaded to receive a brass plug. At the top of Fig. 1 is shown one of these projectiles as taken from the mold. The copper ring is shown cast in position before it has been machined. The point of the projectile is hardened

and the excellent finish imparted by the mold is clearly indicated. In Fig. 5, *B* shows the projectile in the next stage of finishing and *D* is a view of the finished projectile, showing the copper ring turned down, and also the machined groove; *C*, Fig. 5, gives the dimensions of the projectile, showing the location of the copper ring, the upper section of the projectile which is hardened and the lower section which is turned and threaded on the inside.

At *A*, Fig. 5, is shown a United States standard grate bar, 35 inches long which weighs 36 pounds. A permanent mold installed at the League Island navy yard has been designed for making this bar, which heretofore has always been cast in sand. The mold in its closed position for pouring is illustrated in Fig. 6. It consists essentially of two blocks, one stationary and the other movable, each weighing about 1,750 pounds. In the faces of these blocks are machined the reverse of the exterior surfaces of the bar. The air spaces in the grate bar are made by an iron core for the center spaces, and two small sand cores for the ends. The receptacles for the sand cores are prints cut into the faces of the mold and are shown respectively in Figs. 7 and 8. The iron core is hung in position by a double-acting lever, so arranged to give maximum power and slow travel at the start of the motion and swifter travel with less power at the finish of the motion. The action of this lever is clearly indicated in Figs. 6, 7 and 8.

In Fig. 6, which shows the mold in its closed position ready to receive the iron, the core is in its lower or pouring position. The first motion of the lever has as its fulcrum the ends of the long links connecting it to the brackets and applies its power upon the short links connected to the core. The ratio of power here is about 50 to 1 and acts through 90 degrees, which gives sufficient travel to clear the core from the casting. Fig. 7 shows the lever at the end of the 90-degree travel. At this point a plate attached across the levers engages the long links and throws the fulcrum back to the carrying brackets. This reduces the power to about 3 to 1 and increases the travel proportionally. Fig. 8 shows the core clear of the mold.

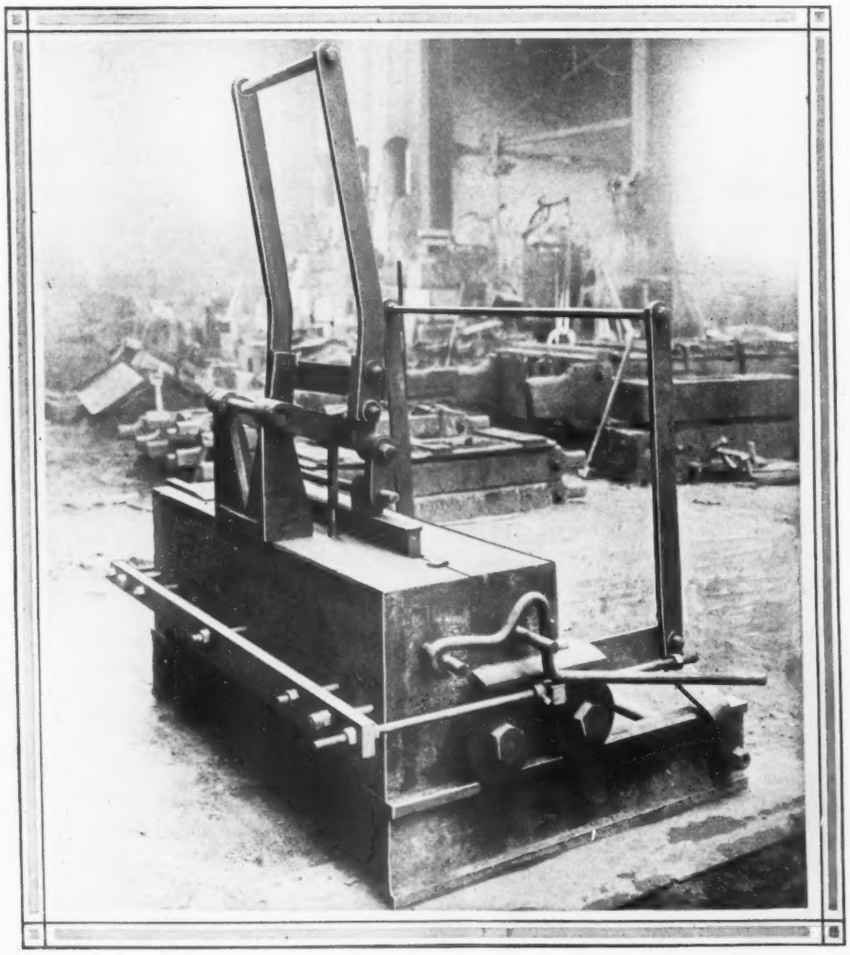


FIG. 6—PERMANENT MOLD FOR CASTING GRATE BARS IN CLOSED POSITION TO RECEIVE THE METAL

The finished grate bar is ejected from the mold by three plungers shown at *A*, Fig. 8. These plungers are attached to a bar carried on two studs in the back of the mold. The position of these plungers is set by two rods, one on each side of the mold, an end of each being attached to the bar and the other ends being passed through eyes in the ends of the movable half of the mold. These rods are each provided with an adjustable collar and a lock nut. The collar is so placed that when the mold is closed the plungers occupy their proper place just flush with the surface of the casting. The lock nut is so adjusted that when the mold is opened wide the eye engages it and throwing the plungers to their out position eject the casting. The various positions of the plungers are shown in Figs. 6 and 7.

As indicated in Fig. 6, the mold is held shut by two spring clamps while pouring. However, these clamps allow a slight flexibility to accommodate the swelling of the iron as it sets. The grate bar is poured by two gates at the ends which are clearly shown in Figs. 7 and 8. The elapsed time for pouring one casting is about 12 seconds. This mold can be poured once every 4 minutes if it is going to be operated for any length of time, but it will stand operating at a more rapid speed if it is to be used for only a short period during each heat.

Car Wheels in Permanent Molds

At the foundrymen's convention in Pittsburgh, June, 1911, the Custer Sandless Casting Co. exhibited permanent molds for casting mine car wheels and at the present time two permanent molds are being tried out, which have been arranged for casting standard 750-pound wheels. The problem of obtaining an adequate chill in the tread has been solved, while the other parts of the wheel can be made as soft or as hard as desired. Another interesting mold recently completed is used for casting fly-wheels for sewing machines. The wheels in every particular are more perfect than those cast in sand and, in addition, the cost of manufacture has been very materially reduced.

Casting Wrought Iron in Cast Iron

Wrought iron frequently causes blow holes, when molten cast iron is poured around it, and one method adopted to prevent this, is to coat the wrought iron or steel with red lead mixed to the consistency of a

thin paint with naphtha. The naphtha dries out, leaving a thin film of the red lead on the iron which causes the molten metal to lie quietly against the cold iron, without blowing. Blowing, however, is due to two causes, oxidation of the surface of the inserted iron and the condensation of moisture thereon. If the metal is clean and bright the tendency to blow is greatly decreased and this is one reason that tinning the iron assists materially. As a dirty surface cannot be tinned, the iron must of necessity be clean, and thus one cause of blowing is removed. The tinned surface also protects the iron from the moisture of the mold, and prevents rusting while it is waiting to be cast. It does not prevent the condensation of moisture, however, and therefore tinning is not infallible as a preventive of blowing. It has been found that when steel bars are inserted in iron castings by pouring the metal around them, a larger percentage of perfect castings can be obtained when the metal is caused to enter the mold, so that the stream strikes the iron and flows around it, thus carrying the first iron away from the bar, and into a suitable flow-off. By this plan the bar is heated, and if blow-holes form at first they are likely to be swept away by the metal that follows and displaces the first iron. In many cases, the hubs of wheels in which spokes are cast, are made in molds formed of dry sand cores, and it follows, therefore, that as no moisture is present, none can condense on the iron, and this difficulty is eliminated, so that it is only necessary to have the iron insertions clean and free from all traces of oxide to obtain uniformly satisfactory results.

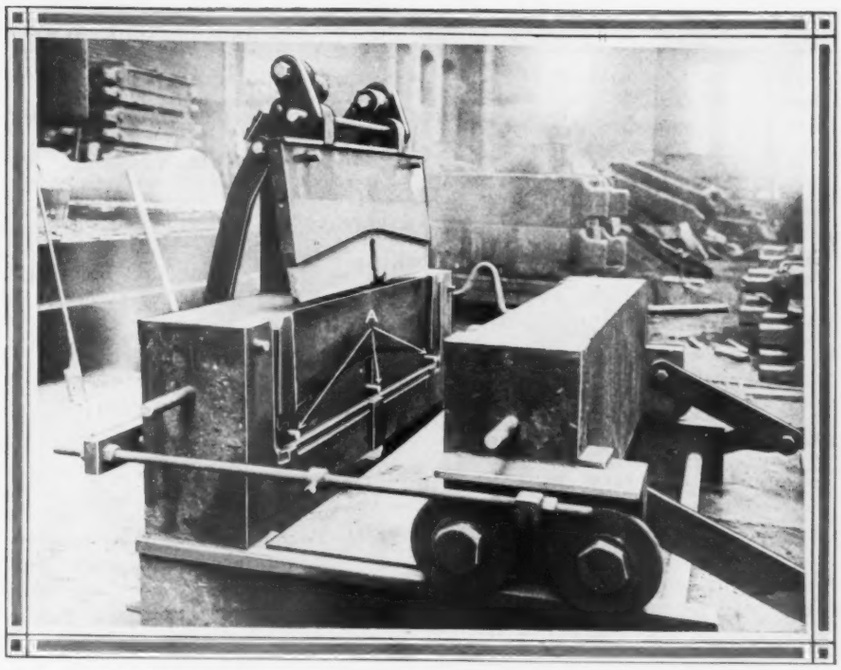


FIG. 8—STATIONARY PART OF PERMANENT MOLD WHICH ALSO SHOWS THE CORE RAISED OUT OF POSITION

Melting Iron in a Ladle

It may occasionally happen that a break-down job at an inconvenient time may create a demand, difficult to fill, for a small quantity of molten iron, and at such times it may come in very handy to be able to melt the required amount in a ladle. Suppose that from 80 to 100 pounds of iron are wanted for a small casting, a ladle that will hold twice that amount should be selected. A cylinder of the same diameter as the ladle should be constructed of sheet iron. It is intended as an extension to the ladle, and the inner edge should be turned over for about ½ inch on the end that will fit on the ladle. This forms a ledge to carry the daubing. After the ledge is formed a hole should be made just above it. This hole should be about 1½ inches in diameter, and is for the insertion of the blast pipe. Both the ladle and its extension should be daubed with fireclay or loam and then thoroughly dried, after which the handles of the ladle are securely blocked so that it cannot tip over. The extension is placed in position on top of the ladle, the nozzle of a blast pipe is inserted, and a fire is started in the ladle. Either coal or coke can be used, and should be small in size. The iron should also be in small pieces in order to melt with greater ease, and is charged similar to a cupola. In this manner from 80 to 100 pounds of iron can be melted in a short time and with a moderate heat. When the iron is melted, remove the pipe, skim the ladle and pour the metal. This method also will be found advantageous for casting small, test heats.

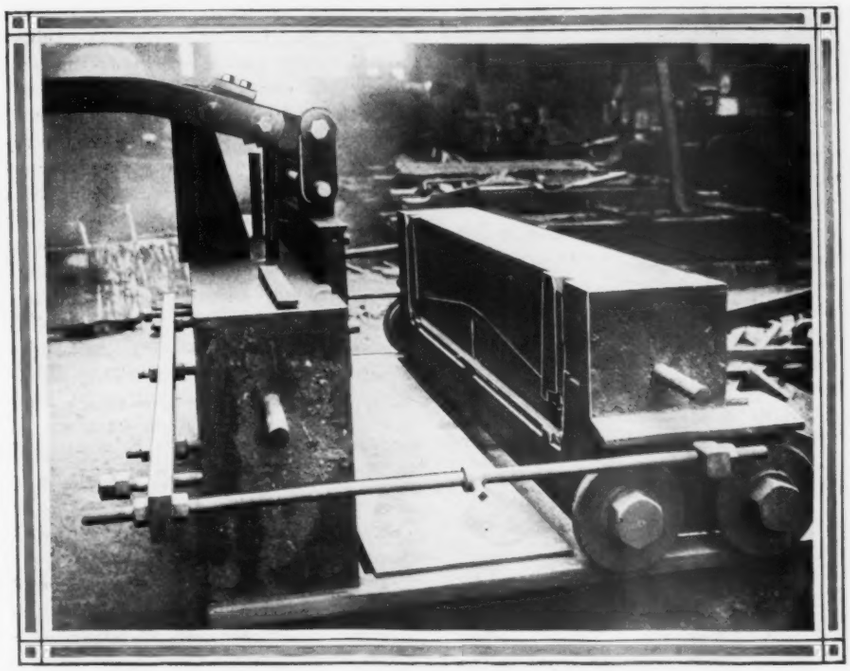


FIG. 7—PERMANENT MOLD FOR GRATE BARS, SHOWING THE FACE OF THE MOVABLE HALF

Suggestions for Preventing Foundry Accidents*

How the American Steel Foundries Solved the Problem of Safeguarding Its Employes from Injury

STATISTICS of injuries and fatalities among industrial workmen have been heralded widely during the past few years. We are told that 30,000 to 35,000 wage earners die from work accidents in the United States every year. In addition to these fatalities approximately 2,000,000 men are seriously injured. It would be difficult to imagine the amount of suffering and distress these accidents bring upon the sufferers and the families dependent upon them. But the economic aspect of this subject is interesting, too. This tremendous array of casualties in a recent year cost $25,000,000 in employers' liability insurance premiums alone. This is the cost to the employer of protection, but it has been estimated that not more than 25 per cent of the insurance premiums reach the sufferers from accident. We are, therefore, face to face with the question of how to prevent accidents, and reduce the suffering and deprivation which these losses entail upon the workmen and their employers, as well as upon society as a whole.

All accidents due to negligence are largely preventable. The means of prevention lies in the direction of: (1) Proper design and construction of plant and appliances; (2) care on the part of employers and employes; (3) the use of safety devices. It must not be overlooked that in the past employers have concentrated their attention on the machinery and equipment of their plants, and overlooked the most important element of all, the care of the human machine. Although considerable stress will be laid in this paper upon the proper design and installation of protective devices, it is believed that at least two-thirds of the accidents which happen in any plant are due to carelessness on the part of the worker and negligence for which the employer and employe are responsible.

It is an easy matter nowadays to secure information from the current journals of the details of organization for carrying out elaborate plans for safeguarding employes, involving the expenditure of large sums of money, but while it is believed that the underlying principles of both large and small organizations are essentially the same, it will be the intention of the author of this paper to define the experience of one of the smaller corporations in its efforts to prevent accidents and protect its workmen to the maximum.

Attempts to Control Accidents

Up to 17 months ago, the American Steel Foundries followed the usual custom of protecting itself from money losses due to accidents under employers' liability policies. Investigations were made several times with a view of ascertaining the probable cost and risk of carrying its own insurance, but on account of the hazardous character of its work, the insurance was continued until it came to the realization of the economies of safeguarding. It then became apparent that the company could control to some extent at least the frequency of accidents among its employes, and this assumption has been borne out by actual experiences. As in other pioneer work, the simplest method was first followed. A general inspection was made of the equipment and buildings at the plants, and recommendations made for the protection of the most dangerous places. When these recommendations were approved the master mechanics at each plant were asked by the managers to supervise the making and installation of the guards, and to report monthly the necessity, if any, for additional guards. This method was only partially successful. The master mechanics were busy men, and more or less calloused by frequent contact with carelessness and indifference on the part of the workmen. As will be shown later, the initial efforts to protect the men were not received kindly, and it seemed futile to foist upon them what they looked upon as handicaps in their work.

Workingmen's Committees

The next step in furtherance of the safety work was the appointing of workingmen's and foremen's committees. Three men were selected from three different departments of the plant, and instructed to make four whole-day inspections during the month. Men were selected who were not only old employes, and familiar with all parts of the plant, but who were known to be conscientious and not afraid to report what they saw. These men were carefully instructed in their work, and informed that the company did not obligate itself to accept any of the suggestions, or do any work. They were paid full wages while engaged on their inspection duties, and $5 each upon presentation of their reports at the end of the months.

These workingmen's committees revealed the immense possibilities at each plant for protection. We received during the first month in all about 1,000 suggestions, and at two of the larger plants approximately 300 each. These recommendations were described carefully in writing, and numbered numerically, and submitted to the three foremen in charge of the departments from which the men were selected, and they acted as a jury in approving or disapproving the suggestions made. The jury of foremen visited and inspected all of the dangerous conditions pointed out by the workingmen's committee, to be in a position to say "yes" or "no" to the recommendations. Only a small percentage of the suggestions were rejected as impracticable. The combined report of the workingmen's and foremen's committees were then submitted to the plant managers, and they expressed their opinion of the reports. The result of the careful consideration of each recommendation from three different standpoints was a warranty to the officials of the company that the final recommendations were probably worthy of acceptance. These committees were continued during the following month, and with about the same results. They were then discontinued for the reason that each plant had so much work to do that it seemed impracticable to pursue the subject further until the recommendations already made had been carried out. Since then, however, similar workingmen's committees have been appointed with continued good results, and it is believed that the workmen in the plants, familiar with every working condition, and having the interest of their self-protection in view, can be as productive as any

*From a paper read by W. H. Cameron, manager of casualty department of the American Steel Foundries, before the Pittsburgh Foundrymen's Association.

other agency in calling attention to the hazards of the industry. By changing the committees monthly the attention of a number of workmen will be in time especially directed to the subject of safety, and this nucleus will help to leaven the lump of the disinterested mass of workers.

The next step in our experience was to find a means of following up the work economically, and at four plants employing approximately 1,500, 900, 700 and 500 workmen, safety inspectors have been engaged to devote all of their time and efforts to the safety, including the inspection of machinery or equipment for broken or worn-out parts, the continued use of which may cause an accident, such as flask trunnions and flanges; the inspection of buildings for loose bricks, pillars, boards and loose material stored overhead; cranes and crane runways for loose parts; use of gongs on cranes; improper riding of workmen on loads being carried by cranes. Also to be on the lookout for slippery places on floors and stairways; holes; broken boards, and protruding nails in boards. To make regular inspections of railroad tracks for guards at frogs and switches; holes about tracks; piling of materials too close to tracks; riding on engines and cars without permission, as well as hoisting cables for broken strands and rust. To oversee the use of scaffolding for painting or making other repairs. The use of congress shoes by foundrymen, and to be on the lookout for loose sleeves while operating machinery. To inspect for the proper and constant use of safeguards. To report narrow escapes from injury, and the causes therefor, and to recommend discipline for workmen or recommendations for additional protection, as well as to report all other conditions about the plant which might be considered hazardous and likely to result in injury to workmen or damage to the company's property. These inspectors are required to attend all meetings of foremen to call attention to unsafe conditions about the plant, and to suggest improvements in the method of handling the work from a safety standpoint.

Attitude of Managers and Foremen

Reports of serious accidents and the causes therefor are also discussed at the meetings of the foremen, and the heads of departments. It is exceedingly important to bring constantly to the minds of foremen the necessity for caution and care in the habits of the workmen. The burden of stimulating the foremen and heads of departments rests almost entirely upon the management of the plant. The manager's and foremen's attitude toward the prevention of accidents will be reflected by the workmen just as accurately as their attitude toward the production of castings is reflected. If the manager treats the subject lightly, his assistants will look upon it in the same way. If he shows a determined desire to avoid accidents, and have the rules of the plant obeyed; if he makes prevention of accidents one of the most important features of his department, then the foremen will reflect his attitude toward the work, and will see that the men take the precautions which are known to be necessary for the prevention of accidents.

Dissemination of Committee's Suggestions

The results of the committees' investigations were forwarded to the central office of the company, and all of the plants have received the benefit of all the recommendations made. The central office keeps in constant touch with the inspectors on safety matters, and when an accident occurs showing carelessness or unnecessary risks taken, or where the use of a safeguard would have avoided the accident, a sketch and safety bulletin is sent to all of the plants, with recommendation as to the avoidance of similar accidents. The central department also has charge of the care and compensation of all injured employes under a voluntary relief plan; receives full reports of all accidents, and when it is apparent that repetition of such accidents can be avoided by cautionary measures, recommendations are made to all of the plants, so that each one receives the benefit of the experience of the other.

The organization of the safety work has, therefore, been conducted through the efforts of committees at each plant; a supervising safety inspector, and the general dissemination of the experience of all plants through a central office. For the smaller collective groups of plants, this plan will be found effective and inexpensive. The safety inspector in a plant employing from 500 to 600 workmen will have ample time to attend to the full investigation of all accidents, and the preparation of all reports, as well as to the visitation of injured workmen, and represent to them the interest of the company in their welfare and speedy recovery. He also can assist the company in reporting workmen who are inclined to magnify their injuries and make fictitious claims against their employers. We believe that these inspectors need not necessarily be experienced men in safety work. Suggestions and photographs of practical safeguards have been distributed so widely and liberally during the past year or two by such corporations as the United States Steel Corporation, International Harvester Co., American Museum of Safety and others that a fairly intelligent young man can soon apply the data at his command to the conditions in the particular plant he represents.

My future remarks will be confined largely to the work which has already been done by the American Steel Foundries for the prevention of accidents at its several plants. It is obvious that the industrial plant that can seriously follow up a plan of accident prevention must undertake: (1) To provide and maintain proper working conditions and efficient safeguards; (2) to educate its employes and inculcate in them habits of caution.

Probably 75 per cent of the accidents in steel foundries affect the eyes of workmen. It, therefore, became apparent at the start that it was necessary to provide all grinders, chippers, floggers, sand blasters, machinists, ladlemen and others with eye protectors which would be suitable and comfortable, and not impede the work or injure the eyes of the workmen. An investigation of the use of spectacles and goggles by other industries revealed the fact that not one had been entirely successful in educating the workmen in the use of any style of spectacles. It was found, however, that the old-fashioned type of grandfather's glasses has successfully protected the eyes of men working at emery wheels, and with these glasses as a foundation to build on the spectacles now in use are worn by about 98 per cent of the employes mentioned. The present design of spectacle is equipped with mesh screens at the sides, and heavy lenses. The total weight is about one ounce per pair. A case is provided with each pair of spectacles, as well as a specially-prepared cloth, and paraffine pencil, used by automobilists to keep their glasses free from moisture and dirt.

Inducements to Wear Spectacles

The next problem was to have the glasses worn by such workmen as chippers and floggers—the majority of whom are foreigners and it was found that these men would not voluntarily use the spectacles. An effort was then made by one of the plants to have the spectacles worn under the supervision of a watchman, who had time to circulate constantly among these workmen, and stimulate

them in the use of the spectacles. Since the employment of safety inspectors this duty has been delegated to them. As an additional stimulus to wear the spectacles, every cleaning room workman was asked to sign a contract with the company under the terms of which he agreed to wear the spectacles constantly, and in the event of injury to his eyes happening while at work without spectacles the company is absolutely free from responsibility for the accident. When spectacles have been broken by flying chips, photographs have been made of them and posted on the bulletin boards about the plants to illustrate the hazardous nature of the work. It is believed that supervision and education along the lines described will have to be adopted in all foundries employing a large number of chippers and floggers, for the reason that these men will not protect themselves voluntarily, and the foremen and their assistants are usually too busy to give special attention to the use of the spectacles.

Protective Value of Spectacles

I have obtained already a collection of 78 pairs of spectacles, the lenses of which have been damaged by flying chips over a period of less than three months. Fifteen pairs of these spectacles were received from one plant in one month. Only one eye has been lost in all of the plants of the American Steel Foundries over the period of 17 months by workmen using these spectacles. In this one instance the piece of steel penetrated the lens with great velocity, and entered the eye of the workman. If the spectacles had not been worn, we believe that a much more serious accident would have resulted.

Another means adopted by our company to protect workmen while cleaning castings, is to provide screens made of canvas, mounted on supports to be placed between the men as they work. The screens have been effective in preventing flying chips from striking fellow workmen, but they are not as complete protection to the individual workman as the use of spectacles.

We also require emery wheels over 8 inches in diameter to have a safety taper of ¾ inch to the foot, and be protected with safety collars. This means that the wheels will be convex in shape, while the collars will be concave, and should the emery wheel break in service, it being thicker at the hub than at the face, the pieces will be held in place. All emery wheels are also protected with cast steel hoods with plates bolted at one side, and the emery wheels used by the workmen grinding tools are provided with plate glass shields to protect the eyes. Care is also taken to keep tool rests closely adjusted to the wheels so that castings cannot be jammed between the wheels and rests.

Dangers From Emery Wheels

Emery wheels often break through mistakes made by repairmen in not changing the speed limits when placing new wheels on spindles. Our safety inspectors are required to test the revolutions per minute of all emery wheels once per week, and check up the speed limits. Wheels are often run at speeds far too great for their diameters. The belts and pulleys of all emery wheels are also protected by metal guards.

Sand-blasters are protected with helmets and respirators, and arc welders with aluminum helmets and rubber aprons covered with asbestos.

Accidents occur in all foundries by feet being burned by slopping metal. It is very important that workmen wear whole shoes, and that they be so constructed that they may be slipped off quickly. We urge upon our workmen the necessity for wearing congress shoes, and we have undertaken to keep a stock of such shoes on hand at all plants, which are sold to the workmen at wholesale prices. The result is that the workman buys the shoes and protects himself from accident, and the company benefits from keeping the workman constantly at his job and by a reduction of the accident expense account.

Safety Appliances for Cranes

All overhead cranes should be provided with walks on both bridge girders, extending the entire length of the crane. Each crane should be provided with safety switch installed on the bridge, which will cut off all power, making it impossible for an absent-minded operator to forget that men are working above, and start the machinery from the cab. Each crane should also be equipped with guards extending out from the truck wheels, the purpose being to warn any person who may be resting his hand on the runway of the approach of the crane which he might fail to notice because of other noises. A number of accidents happen every year to persons working on scaffolds on crane runways. A workman may rest his arm or leg thoughtlessly against the runway, and fail to notice the approach of the crane, and be run over with the loss of one arm or leg.

All trolley gears and truck drive gears should be guarded. The floor should be completely covered so that loose parts will not fall through the openings in the bridge girders of the trolley carriage. This is important both from a safety standpoint and from an operative point of view.

Cables and chains should be inspected regularly. The exposure of crane chains to the prolonged action of the radiant heat of metal in the ladle seems to cause a molecular change in the metal of the links. It is not safe to call this a crystallization, but such broken chain links always show a short and lustrous fracture, which is called crystalline, whether it is really so or not. Frequent inspection, annealing and renewals after a certain period of time are the only safeguards against this.

Necessity for Crane Gongs

Every crane should be equipped with a foot gong. When these gongs were first suggested objection was made that the gongs would not be heard above the other noises in the foundry, but experiment soon proved the value of the warning, and all cranes have since been equipped with gongs. These gongs are also guarded by wire-nets to prevent the gongs from falling on the heads of workmen, should they become disconnected or break in pieces. Of course as a general part of the equipment of cranes, foot brakes should be provided, as well as boxes for oil cans and tools, so that the latter will not be laid around carelessly, and fall on the heads of workmen.

Steel ladders should be provided to enable cranemen to reach their cranes safely. These ladders should be made of angle iron; not pipe.

Band saws should have a hinged guard covering the top and front of the saw to prevent the saw flying should it break, and a head guard extending down from the saw to prevent the workman's head from accidentally coming in contact with the saw. The saw below the table should be encased. We are now trying out a wooden guard, designed in one of our pattern shops, which we expect to prove satisfactory.

We also believe that all pulleys and belts in the pattern shop should be guarded, if there be any danger of timbers being caught in them.

It is also important that the knives of wood jointers be guarded. We have adopted an aluminum guard for this purpose, and it has been found to be satisfactory in every way. It is equipped with a strong spring to

keep the guard constantly in position. We have equipped all of our planers with safety cylinders, which, instead of pulling the man's hand into the knives, throws it out from the machine, and instead of losing his fingers or his hand he sustains comparatively slight injuries. We have not had a report of a serious injury to pattern shop workmen from the use of the planers since the adoption of safety cylinders, and the use of the guard referred to.

Space of Less Value Than Safety

There will be an opportunity in almost all foundries to apply protection to such machines as charging cars, where it is found necessary to provide guards for the truck wheels. Where a railroad track runs close to a building, railings should be placed at the corner of the buildings to prevent men suddenly stepping from the buildings onto the tracks.

Cleanliness about the shop and yards cannot be too strongly urged, as there is no question as to its being a factor in causing men to be more cleanly about their work, and in preventing accidents due to untidy conditions. It is also true that shop windows should be cleaned at regular intervals, and illumination generally may be greatly improved by whitewashing the walls of a dark room at least once a year. This also saves much of the cost of artificial illumination. Mention may be made of the risk of permitting unsuitable clothing to be worn. Leather leggins for the use of belt repairers will minimize the risk of accident as there is considerable danger of these workmen having their trouser legs caught in moving machinery. Gasoline

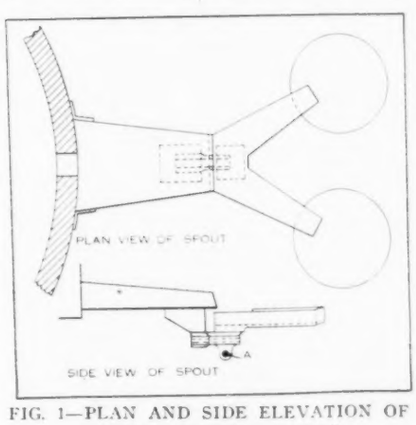


FIG. 1—PLAN AND SIDE ELEVATION OF TILTING CUPOLA SPOUT

should not be carried in open cans. This is frequently done by careless workmen, but it is the avoidance of such accidents as these that assists in the improvement of the accident record.

The insistence on rules and regulations is emphasized by all persons having anything to do with the prevention of accidents, but we believe that these should be used sparingly, and be as brief as possible. They may give legal protection in damage suits for accidents, but they are practically worthless, if no attempt is made to enforce them. We believe that a few effective rules insisted upon by educated foremen, in sympathy with the full protection of their workmen, will be far more effective than a long list of works rules which few will read, and none will remember.

We believe that money and effort expended for the protection of workmen in foundries will be amply returned in the form of a better and more stable organization, and an actual saving in the accident expense account.

A Tilting Cupola Spout

By Geo. C. Kline

When large heats of iron are melted and buggy ladles are used to deliver the metal to the floors, it becomes necessary to stop-up the cupola after each ladle has been filled. This operation is not only difficult, but is the cause of considerable inconvenience and delay. To overcome these difficulties a device was made for attachment to the spout of the cupola which permits a stream of iron to flow continuously. In Fig. 1 is illustrated a plan and side elevation of the tilting cupola spout employed and Fig. 2 is a plan of the industrial track, showing the double spur from the turntable in the main track to the cupola. The tilting section of the spout is Y-shaped, and is pivoted underneath the spout of the cupola in such a manner that it can be rotated, causing either leg to be elevated above the other and deflecting the stream of metal accordingly. Three ladles are used with this arrangement, one under each leg of the Y and one is held in reserve on the main track, near the turntable. In operation, the first ladle is filled with metal and at the proper moment the cupola tender passes a bar through the hole in the projection, *A*, Fig. 1. Using the bar as a lever, he rotates the branched

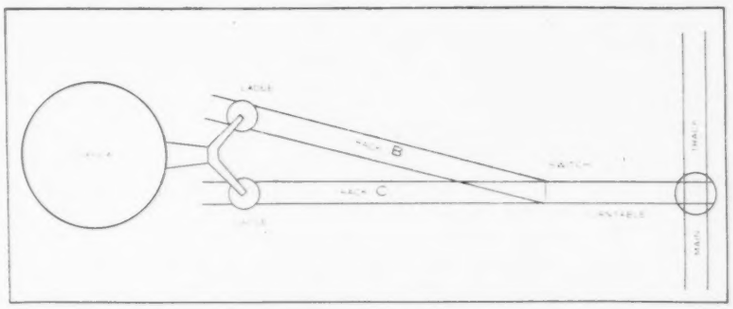


FIG. 2—PLAN OF TRACKS, SWITCHES AND TURNTABLES INSTALLED IN CONNECTION WITH THE TILTING CUPOLA SPOUT

spout in the direction of the empty ladle, thus elevating the leg of the spout over the filled ladle. The flow of the metal then is deflected into the empty ladle on the other track. While the second ladle is being filled, the first ladle, filled with iron, is pushed down to the turntable and is transferred to the main track. The reserve ladle, after passing the turntable and switch, is moved to the point near the cupola previously occupied by the filled ladle and another reserve ladle is placed in readiness near the turntable on the main track. When the second ladle is filled, the stream of iron again is diverted by rotating the spout toward the empty ladle, and the filled ladle is replaced by another empty vessel. This operation is repeated alternately throughout the progress of the heat.

Core Oven Installations

The J. D. Smith Foundry Supply Co., Cleveland, has furnished practically all of the equipment for the new foundry erected by the U. S. McAdamite Metal Co., Detroit. This plant will be devoted exclusively to the production of aluminum castings, largely for automobile work, and in addition, McAdamite metal will be manufactured for the trade. The shop is approximately 80 x 150 feet, and the Smith company furnished three oil-fired core ovens of the car type, eight oil-fired aluminum furnaces, as well as other miscellaneous equipment. Core ovens also have been recently installed by the Smith company in the shops of the Medina Foundry Co., Medina, O.; Muncie Foundry & Machine Co., Muncie, Ind.; 10 core ovens for the plants of the Aluminum Castings Co., Detroit, and two for the Frontier Iron Works, Buffalo.

Molding Large Castings in an English Foundry

Methods of Molding Large Gray Iron Sections for Turbines and Engines for Marine Service

MODERN ship building requirements have contributed largely to the recent advancement in the art of founding. To meet the demands imposed by naval service, the output of large castings has been continually increased. New metals have been developed and methods of casting devised to insure the highest physical qualities of the product. Gun metal, whether ferrous or non-ferrous, has always borne high reputation, and before the application of steam to marine propulsion the casting involved the greatest skill of the founder. Some remarkable ordnance castings were produced by the early foundrymen, and skill in this art was confined to no one nationality.

The Dardenelles was defended by some enormous bronze cannon cast by the Turks, which hurled stone projectiles. The great gun of Russia, cast by Theodor Chockoff in 1594, during the reign of King Theodor, weighed 86,400 pounds. This gun was also made of bronze and would have been considered a notable casting even at the present time. It was 17 feet, 6 inches long, 4 feet in outside diameter and 3 feet in diameter inside. It contained a powder chamber 1 foot in diameter and from 5 to 6 feet long. After cast iron came into favor for gun making, the size of these castings steadily increased until it was not unusual for from 250,000 to 300,000 pounds of molten iron to be poured into one mold. The metal was always melted in air furnaces and the molds for the guns were cast upright in pits. The pit in the plant of the South Boston Iron Works was 40 feet deep and 11 feet in diameter, and was enclosed by walls 12 inches thick.

Cannon With Water-cooled Cores

The making of these huge castings was a very dangerous foundry operation, as they were cored out in the center and a steady stream of water, under pressure, was kept flowing through the core, not only during the time it was being poured, but for several days thereafter, until the casting solidified and cooled. The object of the water-chilling was to increase the density of the metal, which was effected by causing the casting to solidify from the center to the outside in layers, each layer shrinking onto the previous one. No great flight of imagination is required to appreciate the disastrous consequences that would have attended the leakage of water through the core, during the time of pouring, or afterwards while the metal remained in a molten condition.

The cores were made of loam swept up on a solid barrel. The core barrel was tightly wound with hay rope, over which were swept two or three coats of loam. The core was vented by grooves planed in the barrel, which extended its entire length. The cores were sometimes steadied at one end by a depression in the bottom of the mold, or by an anchor, but cores from 16 to 20 feet long have been suspended in

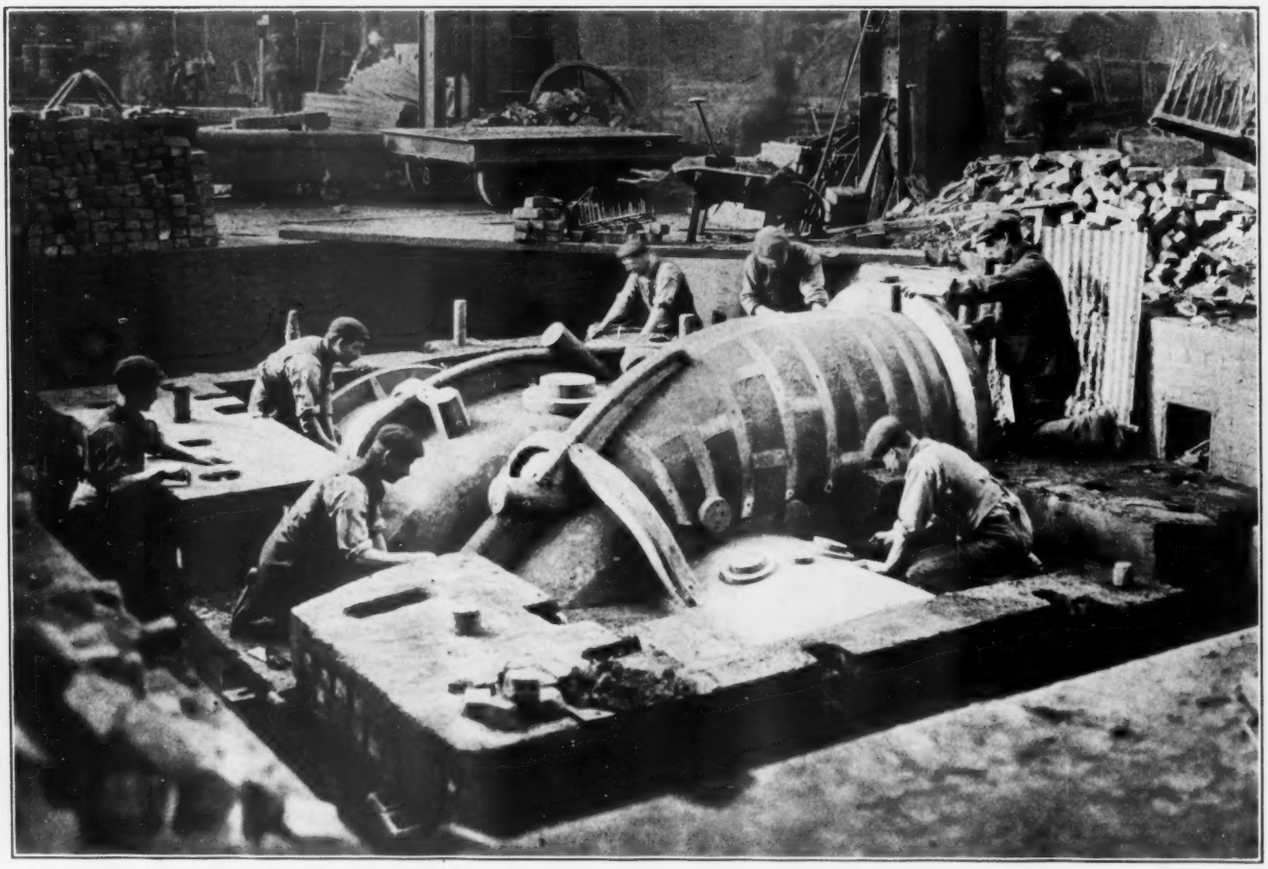


FIG. 1—MOLDING THE BOTTOM HALF OF THE ASTERN TURBINE FOR H. M. S. LION, IN THE FOUNDRY OF VICKERS, LTD., BARROW-IN-FURNESS, ENG.

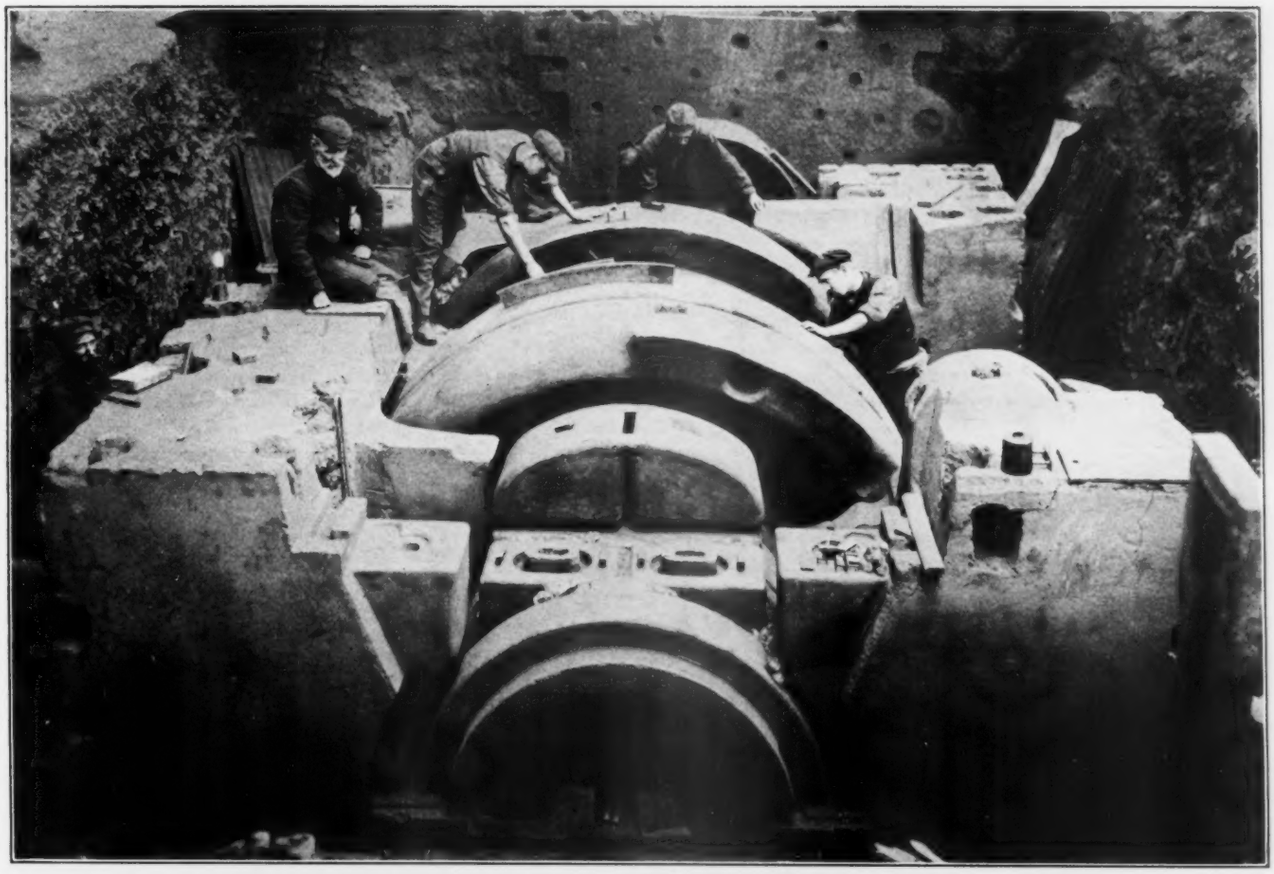


FIG. 2—SETTING THE CORES FOR THE BOTTOM HALF OF THE ASTERN CYLINDER

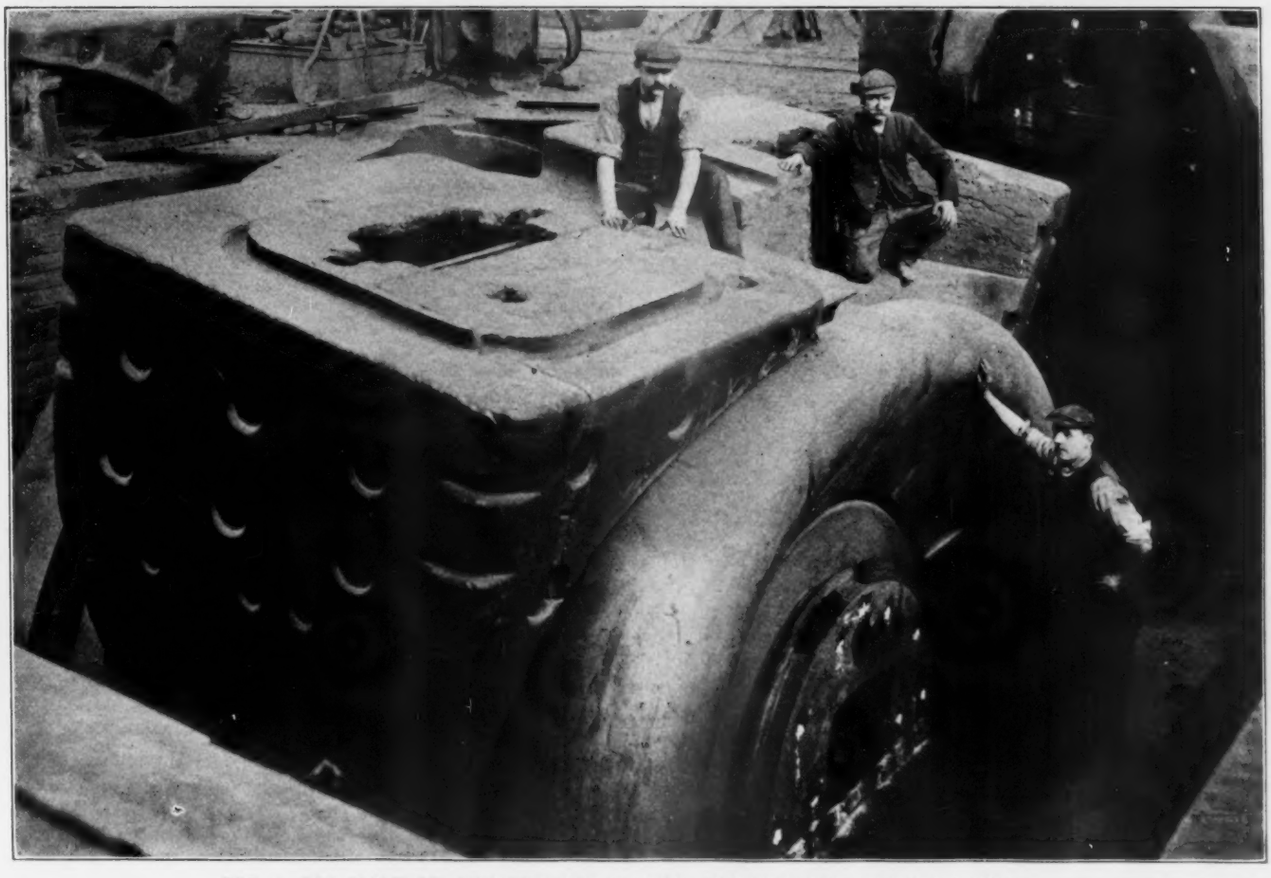


FIG. 3—TOP HALF OF THE TURBINE CASING, SHOWING THE EXHAUST END

molds for muzzle-loading guns without any support, other than a tripod at the top. The castings were usually gated from the bottom, two sprues being used, and the mold was built-up of flask sections, corresponding closely to the shape of the cannon. The flask had to be exceedingly strong to withstand the pressure of from 125 to 150 tons of molten metal at the bottom of a mold 40 feet deep.

It was only occasionally that sand was rammed between the flask and the sides of the pit, but sometimes accidents occurred, as for instance in 1884, when a flask broke while a gun was being cast in the foundry of the South Boston Iron Works. The metal flowed into the pit and formed a solid mass 11 feet in diameter and 7½ feet thick which weighed 137 tons. It required three months' work to remove the iron from the pit.

Water-cooling the Core

The core arbor had to be exceedingly strong and at the bottom it was usually several inches thick. The water flowed through a pipe in the center of the arbor, being connected at the upper end to the water supply, while the lower end terminated several inches from the bottom of the arbor. The water flowed down through this pipe and passed up through the core arbor at the rate of about 45 gallons a minute. In spite of the tremendous amount of heat radiated to the core by the mass of metal, the water flowing from the arbor was not warmed appreciably, owing to the rate of flow maintained. After cooling, the guns were hoisted from the pits either by hydraulic power, or by screw jacks, and were then moved on rollers to the machine shop, as in those days the capacity of foundry cranes was not equal to the task of swinging out such heavy castings.

The casting of shot and shell also entailed accurate foundry work, as the thickness of the walls of hollow shot had to be uniform, otherwise the projectile would deviate from its course.

Steel castings are now used extensively in ship construction and exceedingly intricate castings are required in the framework of large vessels. A rudder frame recently cast for an English cruiser was 26 feet long and had three arms or wings, that stretched out from the barrel a distance of over 23 feet; 60 tons of steel were required to pour the casting. Propeller shaft brackets are chiefly remarkable for their large size and awkward shape, rather than for their weight.

Large Turbine Casing Molds

Powerful marine engines require castings of large size, although the introduction of the steam turbine has not materially increased the dimensions of the sections for these machines. The accompanying illustrations show molds for turbine castings in various stages of construction. These castings were made in the foundry of Vickers Limited, at their Naval Construction Works, Barrow-in-Furness, England. In Fig. 1 is shown a partly constructed mold for the high pressure astern turbine casing of a cruiser, the pipe shaped portion of the mold being the exhaust branch, and the curved surface on which the molder is working is the bearing block. Fig. 2 is a view of another mold in an improvised pit dug in the foundry floor. This mold, it will be noted, is largely constructed of dry sand cores, while the greater part of the mold shown in Fig. 1, is made in loam. Fig. 3 shows the cores for the

FIG. 4—CLEANING THE LARGE TURBINE CASTINGS

top half of the low pressure casing, the exhaust ports being clearly shown. In the background is another section of one of the cores. A view of the cleaning department, showing the castings made in the molds previously described, is shown in Fig. 4. At the left is one of the bearing blocks and in the center are the top and bottom halves of a turbine casing. Some of these castings weighed 70 tons, and, although they are small when compared with the guns previously mentioned, much greater skill was required in the actual construction of the mold. Many other castings are required in naval construction other than those referred to, one of the most important of which is the propeller. In sea-going vessels these castings are usually made of a non-ferrous alloy that will resist corrosion. Manganese bronze has been used more extensively than any other alloy, and has proved satisfactory in all cases where reciprocating engines are employed for propelling vessels. It has been found necessary to abandon this alloy, however, in the case of turbine-driven vessels, and Monel metal is at present extensively used for salt water wheels. Manganese bronze owes its invention to marine requirements, and both Muntz and Delta metals are extensively used on vessels. In the days of the wooden ship these metals were largely used in the form of sheathing, to protect the bottom of the vessel. One of the most notable uses to which they are put in modern vessels is for condenser tubes, the corrosion of which is now the subject of investigation.

Molding Cylinders on an Electric Jar-Rammer

COMPARATIVELY few shops making a general line of castings care to undertake the production of a large number of gasoline engine cylinders unless especially rigged for the job. Nevertheless, the problems of cylinder molding are by no means unsurmountable, even for a foundry which generally produces an entirely different line of castings. It is the purpose of this article to describe how a large number of gasoline engine cylinders were made successfully and economically in the foundry of a prominent western machinery manufacturer. This company builds electric traveling cranes, hoists, grab buckets, etc., and its foundry is, therefore, not especially equipped for cylinder work. The job was handled, however, without delay and in an economical manner. In executing this order mechanical molding methods were used as far as possible to save expense and to produce uniform results. The molds were rammed on an electric jarring machine furnished by Henry E. Pridmore, Chicago, and a Pawling & Harnischfeger single line grab bucket was extensively employed in handling the sand.

The Cylinders

The cylinders were for large, double opposed engines, designed to drive gasoline tractors. They are approximately 8 inches in diameter by 10 inches stroke. Each cylinder is cast integral with half of the crank case, the whole piece weighing about 500 pounds. Twelve cylinders were cast per day and were molded in about five hours time, three molders and four helpers being employed on the job.

Special flasks made of ¾-inch cast iron plates bolted together were used. The cope and drag for each flask was approximately 3 feet, 6 inches long, 3 feet wide and 2 feet, 6 inches deep. The end plates of the flasks were ribbed and provided with trunnions so they could be easily handled by the crane and rolled over while in the air. A large number of holes about ⅝ inch in diameter, were cored through the side plates to permit the gases from the mold to escape. The construction of the flasks is clearly shown in the accompanying illustrations. Five cast iron cross bars were fitted in the cope; three of these were cut off about 6 inches below the top of the cope so as to avoid ramming an unnecessary amount of sand over the upper or smaller part of the casting.

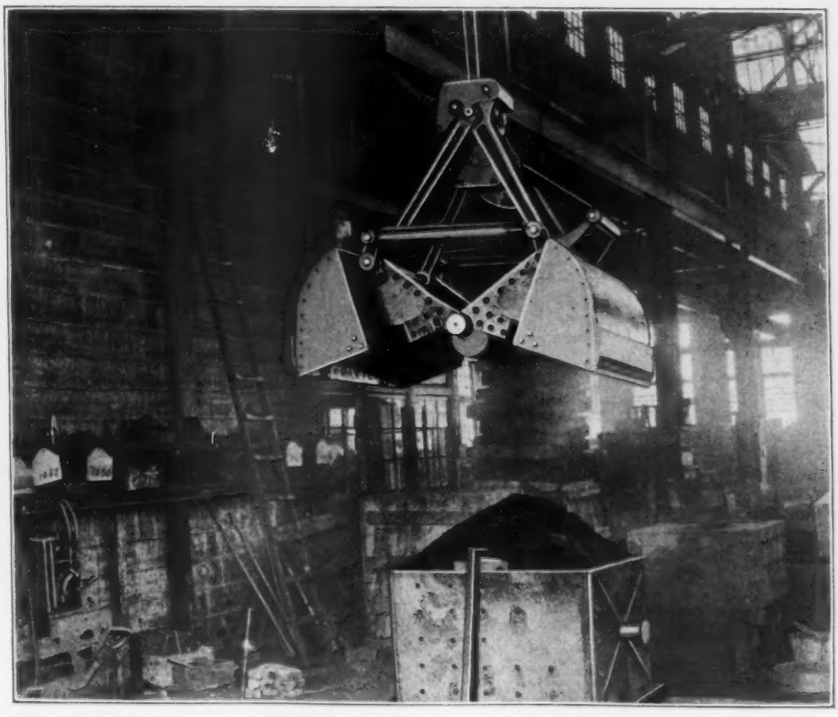


FIG. 1—GRAB BUCKET USED FOR FILLING FLASK ON ELECTRIC JAR-RAMMING MACHINE

Each half of the pattern was fitted with dowel pins which engaged corresponding holes in the bottom boards, thus holding the pattern securely in place. Separate bottom boards were provided both for the copes and drags. These were about 3 feet, 8 inches by 3 feet, 4 inches in size and were built of two layers of 1-inch plank placed with the grain running at right angles and faced on top with a ⅛-inch steel plate screwed to the planks. This plate forms a smooth surface for the pattern to lie on. The deep plane draft surfaces of the pattern were faced with brass plates.

The flask was clamped, as indicated in Fig. 1, and was placed on the table of the jarring machine. The facing sand, composed of one part sea coal to eight parts fine sand, was carefully riddled over the pattern. The

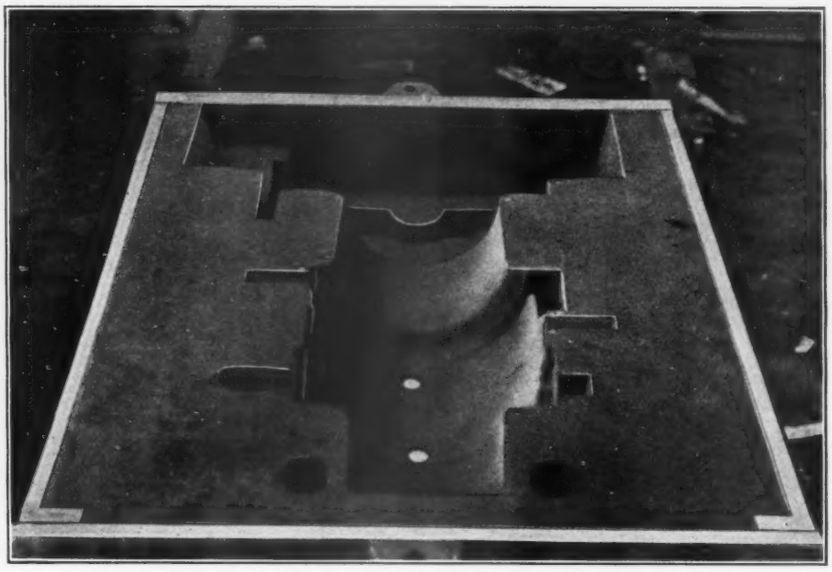


FIG. 2—COPE HALF OF THE MOLD AS IT APPEARED IMMEDIATELY AFTER THE PATTERN WAS DRAWN AND CHAPLETS SET

balance of the flask was filled heaping full with the grab bucket, as indicated in Fig. 1, from a sand pile adjacent to the machine. The cope and drag for each mold were given about 40 bumps on the Pridmore electric jarring machine, this process requiring approximately 37 seconds for each portion of the flask. The total time required to ram one mold was, therefore, not in excess of 1¼ minutes. Although the machine rams the sand very evenly and solidly, it was found advisable to use gaggers in the cope on account of the relatively large unsupported masses. The jarring machine is the standard Pridmore type, equipped with a 5-horsepower motor and a friction clutch.

The Drag

The drag, after being rammed, was removed from the machine by the traveling crane, rolled over in the air and placed on the floor for the reception of the cores. The copes were also rolled over and set on the floor for finishing. Fig. 2 shows one of the cope molds immediately after it was lifted from the jarring machine. The molds were not dried in any way, but were slicked over with a layer of plumbago. All parts of the mold were carefully nailed to prevent the sand from tearing loose.

Fig. 3 shows the drag with the cores set ready for closing. As indicated at *G*, two pouring gates are provided at the top end of the cylinder. There are also two risers at the opposite end, attached to the crank case. A solid baked core is used to form the interior surface of the cylinder and crank case and an annular core which slips over the cylindrical one, forms the water jacket space. The latter is held in place by lugs or projections, *P*, and also by chaplets, placed in the cope. The projections are hollow and provide an outlet for the gases generated in the jacket core. In order that there may be free vent, a leather thong is placed in the parting between the cope and drag, extending from the end of the core projection to the side of the flask. After the flask is closed the thong is removed, leaving a channel for the escaping gases. The gases from the large core escape through vents at each end. The jacket core is about ¾ inch thick, 10 inches inside diameter and 11 inches in length. It is slipped over the cylinder core and the two are set together with the traveling crane, two men being employed to steady them into place. The cylinder core is made in halves in a core box. The pieces are dried and pasted together after being removed from the oven. These cores are heavily rodded in order to have sufficient strength to withstand the pressure of the metal. The jacket cores are also made in halves which are bound together by wires. The metal is melted in a cupola and poured hot, a 40 per cent steel mixture being used.

Shaking-Out by Machine

The electric jarring machine is used to good advantage, not only to ram the molds, but also to shake them out. When the first few castings were made they were shaken-out by hand, using sledge hammers and the traveling crane. This involved about seven hours work in handling the day's output. Now the cope and drag from each mold are placed successively on the jarring machine, properly blocked up and the mold is shaken-out with about three bumps. The sand does not have to be carried, but is merely piled up beside the machine where it will be used again.

After the flasks are shaken out, the castings are placed in an inclined position on a rack in the cleaning room. The core sand is then removed with a sledge and bar and the rough portions of the casting chipped off. After this operation is completed the final chipping and cleaning is done preparatory to sending the casting to the machine shop.

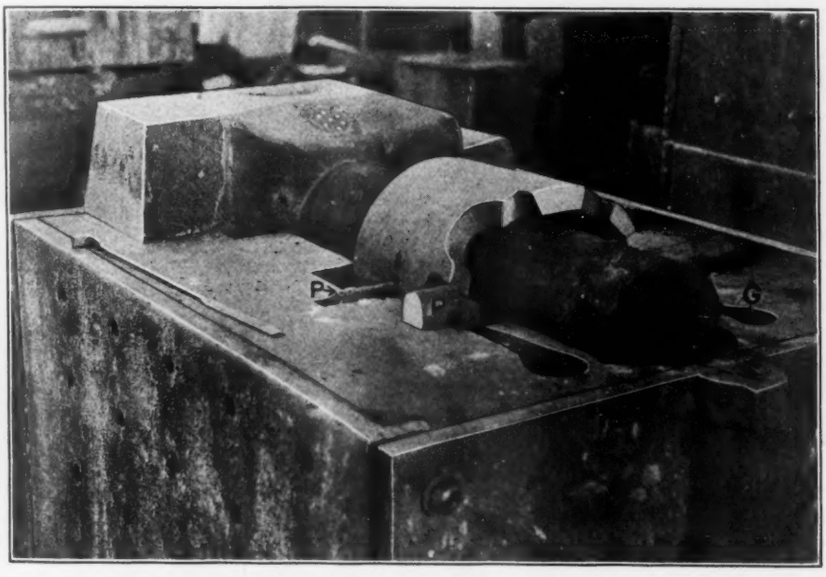


FIG. 3—DRAG HALF OF CYLINDER MOLD, SHOWING CORES IN POSITION

THE BRASS FOUNDRY

Molding Ornamental Bronze Castings

By C Vickers

IN THE two previous articles of this series published in the January and February issues of THE FOUNDRY, the *cire-perdue* or lost wax process was discussed and some of the details of this method of molding were outlined. Briefly, this process consists of making a wax replica or pattern of the casting desired, enclosing it in a mold made of a self-hardening refractory material, then melting out the wax, which leaves a cavity into which the metal is poured. For making small castings of silver and bronze, this process is extensively applied in this country, but the majority of the larger castings are made by the French sand method of piece-molding. Some very large work has, however, been produced by the lost wax process in American shops, and one foundry in which the *cire-perdue* method is practiced on a large scale is operated by the Roman Bronze Works, Brooklyn, N. Y. This plant was established about 14 years ago, by Ricado R. Bertelli, and consists of a frame foundry building, 90 x 150 feet, and a brick building, 60 x 100 feet, used for plaster molding and as a finishing shop. The melting equipment consists of eight crucible furnaces with a capacity of 450 pounds of metal each per heat, and a small cupola furnace. The lost wax process, as practiced at this plant, differs radically in its essential features from the casting methods common to gray iron, steel and brass. Its ultimate aim is the reproduction of all the most minute lines and artistic details of the original model, and requires skilled and careful workmanship.

Accurate Reproduction by Cire-perdue Process

The process is typically artistic in all its features and the extent to which the reproduction of detail can be carried, is illustrated by the fact that frequently slight finger prints inadvertently left by the artist upon his plastic models, are reproduced clearly and accurately upon the finished bronze.

One of the castings recently made at these works was illustrated in the November, 1911, issue of THE FOUNDRY, page 128. This group was modeled by Henry Merwin Shrady, and forms one of two groups which are to adorn the Grant memorial that is being erected in front of the capitol at Washington. It was cast in 15 separate pieces, the largest of which were half portions of a horse and rider, each weighing about 3,000 pounds. In fitting together the different parts, what is termed a Roman joint was used. This consists of a flange cast on the inner edge of one of the pieces that forms a recess, into which the adjoining piece is fitted. The latter is then drilled with corresponding holes in the flanges, which are threaded. The holes in the piece to be attached are countersunk and the two parts are securely fastened together by bronze

FIG. 1—VIEW IN THE FOUNDRY OF THE ROMAN BRONZE WORKS, SHOWING ONE OF THE CASTING PITS CONTAINING A MOLD

FIG. 2—CHASERS WORKING ON PARTS OF THE BRONZE DOORS FOR THE CHURCH OF ST. BARTHOLOMEW, WHICH WERE CAST BY THE *CIRE-PERDUE* PROCESS

bolts. These are afterwards chased until invisible. The joint is usually placed along some sharp line of the casting, which covers the seam and makes it difficult to detect. The malleability of the bronze is a material aid to the skillful execution of this finishing-off process. The lap or flanges left for the joint are usually ¼ inch wide and ⅛ inch high.

A companion piece to the artillery group is now being modeled by the sculptor. It will consist of a cavalry group of horses and troopers, and will adorn the side of the memorial opposite the artillery piece. The center figure, upon which work is also going forward, will be an equestrian statue of General Grant. This will be flanked by four symbolic lions, and by eight ornamental lamp posts, which have been completed by the Roman Bronze Works, and are now in position upon the pedestal. On either side of the marble base for the equestrian figure, are two panels, 9 x 9 feet. The monument when completed will represent all branches of the army. The figures are of heroic size and are reproduced in action with the exception of the general, who will be shown in a calm attitude sitting on his horse directing the movements of his forces. The entire monument, when competed, will be 262 feet long, and the total cost about $250,000.

FIG. 3—A SECTION OF THE MOLDING ROOM, SHOWING THE APPLICATION OF WAX TO A PIECE MOLD

Reproducing the Sculptor's Model

When a casting of a statue is to be made, the sculptor usually gives to the brass founder a complete plaster of paris model of his original work. In the case of the casting for the artillery piece, the Roman Bronze Works made a piece mold in plaster, direct from the original model in the studio of the artist, which carried in reverse all the fine lines of the subject. It required the labor of two men, working for about a year to make a complete negative cast of the entire group in plaster. After the negative was made in plaster or gelatine, the wax was applied, at first in liquid form by means of a brush, in order to obtain a perfect reproduction of all the fine lines of the

FIG. 4—VIEW OF ONE CORNER OF FINISHING ROOM; THE WORKMAN IN THE CENTER IS FINISHING THE BASE FOR A STATUE

original. Upon this first coating, the wax was applied in sheets and was pressed into shape by hand, until a thickness ranging from ¼ to ¾ inch was obtained, varying with the thickness of metal desired. This stage of the process is indicated in Fig. 3, which shows a view of a section of the molding room illustrating the application of the wax to the various parts of a piece mold. Another view of the molding room is illustrated in Fig. 5, which shows the artist touching-up a wax model at the left, and in the foreground one of the workmen is engaged in opening a plaster mold after the wax has been poured and has set. In Fig. 4, a view of one corner of the finishing room is shown, and the workman in the center is engaged in finishing the base for a statue that has been cast separately. Another view of the finishing room is shown in Fig. 2. The various bas-relief castings are parts of the doors of St. Bartholomew's church, New York, which were presented to the church by Mrs. Cornelius Vanderbilt. The castings were made by the *cire-perdue* process, and in the illustration are in course of being finished by the chasers.

After the wax model has been made, it is retouched by the artist and wax rods to form the gates and vents are attached, bronze rods are inserted for chaplets, and openings are cut where necessary to permit the core material to flow into the shell. The mold is then built-up in the manner previously outlined, the molding material being at first applied with a brush, after which the thickness is increased by hand. The mold, when completed, is heated to melt out the wax, and one portion of the plant, especially equipped for this work, is provided with pits in which the wax is melted out of large molds and in which they are afterwards baked. In the case of the smaller molds, the wax is melted out on the foundry floor, a brick oven being built around them, as shown at the left of Fig. 1. A slow

FIG. 5—ANOTHER VIEW OF THE MOLDING ROOM, SHOWING AN ARTIST TOUCHING UP A WAX MODEL, AND A WORKMAN OPENING A PLASTER MOLD

FIG. 6—BRONZE ORNAMENTATION OF THE GRAND STAIRCASE IN THE ROTUNDA OF THE CAPITOL BUILDING AT DENVER

FIG. 7—BRONZE DOORS OF THE GOVERNMENT PRINTING OFFICE AT WASHINGTON

coke fire is used to heat the mold to a temperature of about 500 degrees Fahr. The wax, when melted, flows from the mold, and is collected for future use.

Detection of Wax in Finished Mold

Every trace of wax has to be removed, and this is ascertained by exhausting the air from the mold. This is accomplished by inserting thin tubes, bent to follow, as far as possible, the contour of the mold. The presence of wax is detected by the scent of the air extracted and this method has been found very effective. After the wax has been removed, the mold is inverted so that the gates will converge at the top. If the mold is of small size, it is rammed in a flask, but if large, it is rammed in a pit in the manner shown in Fig. 1. This illustrates the method of handling a large mold. After the mold has been poured, the casting is allowed to cool from one to two days, according to its size. The plaster composition forming the mold is quite easy to remove, after it has been burned by the metal. The gates, risers, vents and fins are removed in the finishing room, and little further work is required on the casting, other than scratch-brushing to remove particles of the mold. Owing to the delicate lines of the casting, all the finishing is done by hand, after which the surface is treated by chemicals to bring out the desired patina.

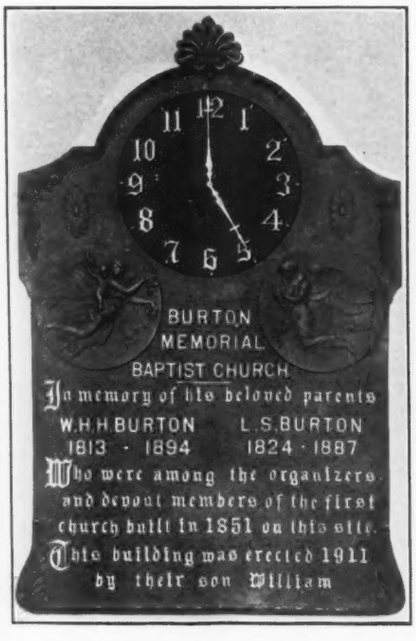


FIG. 8—BRONZE MEMORIAL PLATE AND DIAL PLATE MADE IN A SOUTHERN FOUNDRY

Ordinary sand molding is also practiced by the Roman Bronze Works, this method being followed for all castings free from undercuts, such as the wheels of the cannon in the artillery group, tablets, bases of statuary and general architectural work.

A fine example of the latter class of work is illustrated by the bronze lamp standard, Fig. 10, made by the Snead & Co. Iron Works, Jersey City, N. J. While most of this work is of such a nature that it can be made in sand by ordinary methods of molding, a high degree of skill is nevertheless required in making the castings. They are usually quite thin and the core not only has to be centered accurately, but must be so firmly anchored that there is no possibility of its springing and cutting through into the cope. A casting such as this lamp post is seldom made integral as it is much easier to make it in sections which are afterwards assembled. The lamp standard illustrated, could be made in three parts, the smallest being the cross-shaped casting on top that supports the lamps. One division could be made at *A*, another at *B*, and the part of the post between *A* and *B*, would be the largest part of the casting. This could be molded horizontally and portions of the ornamenta-

FIG. 9—A SECTION OF THE ORNAMENTAL BRONZE RAILING IN THE COLORADO STATE CAPITOL BUILDING AT DENVER

tion which would tear the sand could be formed by loose parts of the pattern. These could be withdrawn sideways, after the main pattern had been removed from the mold.

While the base could be readily molded in one piece, such castings are sometimes made in sections, which are fastened together by screws or rivets. If cast integral, it is necessary to use a core for the inside, and the ornamentation at *C*, is formed by loose pieces on the pattern that are withdrawn at an angle different from the main portion of the pattern.

Decorative Value of Bronze

Bronze is a metal peculiarly adapted to interior decorative work, and with the advancement of a nation in wealth and refinement, the use of bronze for this purpose continually increases. The vestibule of the modern office building is frequently adorned with bronze doors paneled with glass, and set in a framework of the same material. Cast bronze is also frequently employed in the construction of elevator cages, and also for the grille work in which they are enclosed. The character of bronze architectural work varies with the type of building in which it is employed. In office buildings, plain designs and straight lines predominate, while in public edifices the bronzes are often highly artistic and ornamental. A beautiful example of this latter type of interior bronze work is illustrated in Fig. 6, which shows the bronze balustrade, side paneling, newel posts and lamp standards of the grand staircase in the rotunda of the capitol building at Denver, Colo. A section of bronze railing in another part of the same building is shown in Fig. 9, which clearly shows the ornamental character of the

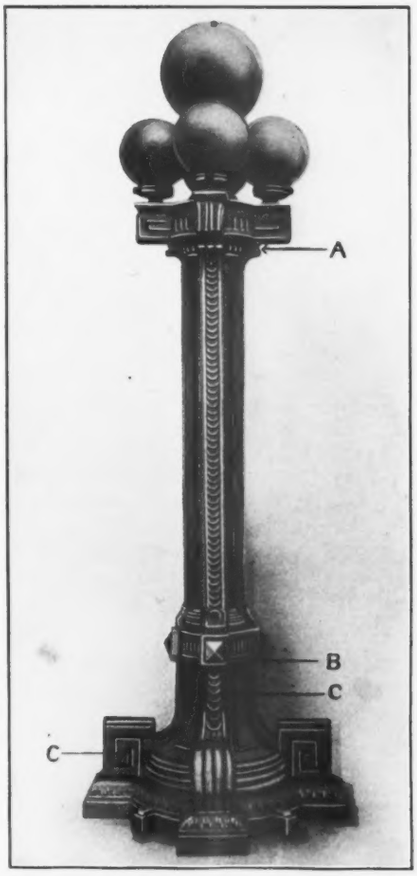


FIG. 10—AN ARTISTIC BRONZE LAMP STANDARD.

design. An example of plainer bronze architectural work is illustrated in Fig. 7. This shows the bronze doors of the government printing office at Washington.

The lattice work over the door is a bronze casting in one piece, while the door itself is built-up of sectional castings of bronze and brass. This door is the product of the Snead & Co. Iron Works, Jersey City, as is also the bronze work of the Denver capitol building. That the production of artistic bronze castings is not entirely confined to any one section of the country is indicated by the quiet elegance of the memorial tablet and dial plate, shown in Fig. 8. This tablet was cast in the foundry of the Koretke Bros. Brass & Mfg. Co., New Orleans.

Wide Range of Architectural Castings

Castings for architectural purposes cover a wide range. Both cast iron and bronze are used for this purpose, but while the use of the latter metal is increasing, that of cast iron is diminishing. A decade ago the architectural iron foundry was a distinctive institution in the foundry trade, but owing to the development and use of rolled structural sections and the introduction of reinforced concrete its importance has declined. The cast iron lintel with its ornamental rosettes separately cast and attached with screws, is found only on the older buildings, having been superseded by the steel I-beam, the flanges of which carry the brick work. Large quantities of these cast lintels were made at one time, as well as columns

to support the floors and for the fronts of stores. Some remarkable work was turned out along architectural lines in unexpected places, such as the casting of large columns or capitals in backwoods shops. In one case, columns about 3 feet in diameter by 20 feet long were cast with a green sand core in a shop whose equipment consisted of a squeaky jib crane fitted with a hemp rope. The ornamentation for these cast iron columns and other building material, was always cast separately and fastened onto the main casting, whenever there was undercutting, as in the case of the rosettes on the lintels. Therefore, the only remarkable feature of these castings, was the fact that they were made in such small shops, not equipped with any of the facilities which the modern molder considers indispensable.

Molding Undercut Ornamentation

In work of a higher grade, both in cast iron and bronze, undulating ribbons often form a part of the ornamentation, and the curves are frequently much undercut. Sometimes the ribbons are cast separately and pinned onto the casting, but usually they are cast on solid, and in such cases some delicate pattern work is necessary to enable them to be withdrawn from the green sand mold without breaking away the sand, or using cores which, in all probability would leave unsightly marks behind them. The undulating ribbon must be loose from the main pattern, and should be divided into as many pieces as there are changes in the contour of the undercut portions, so that each undercut section can be withdrawn at any angle necessary to avoid breaking the sand.

Difficult Undercut Sections

In some instances a portion of the ornament may be undercut on both sides, being similar to a V in cross-section, the narrowest part being the junction with the pattern. This section can be molded in green sand by splitting it longitudinally into three parts, and the center part having straight sides is drawn first, the two undercut sides being drawn sideways into the cavity left by the withdrawal of the center. It is evident, that if the three parts of the V-shaped portion of the ribbon are merely fastened to the main pattern with dowels, or are pinned, and the pins are removed after the sand has been rammed around the loose pieces, they might be displaced or tilted to one side. To avoid this difficulty, it is customary to arrange the pattern so that the center of the V can be withdrawn from the inside of the main pattern before the latter is removed from the sand. The main pattern is always hollow and the center of the V is attached to a slot that holds it firmly in position. The loose sides forming the undercut are pinned onto the center piece from the outside of the pattern, and the pins are removed when the sand has been rammed around these sections. They are, therefore, left in the mold when the pattern is drawn, and are removed when the mold is being finished. Considerable skill is required to properly secure all these undercut sections, so that the sand will not be washed away. The sand must be well supported by nails, and in addition, the molds are usually skin dried. On well made patterns for architectural work, ornamented with foliated ribbons, the several sections into which the latter are divided are loosely attached to the main pattern by being fitted into a channel cut into the thickness of the pattern, and the sides of this channel are so tapered that, while they hold the loose pieces solidly in position, they permit their free separation from the pattern. This method is preferred to doweling, in the case of long, narrow, loose pieces. Raised figures, such as scrolls, floral designs and moldings that have to be loose on the pattern, are attached by dowels inserted from the inside of the pattern, which are removed before the latter is drawn.

Fine Castings a Requisite

Bronze castings for architectural work should be clearly outlined and should be of a smooth surface. To attain this, the molds are faced with fine sand and are skin dried before they are poured. Great care is required when ramming for ornamental castings to avoid *ramming away*. This trouble is especially liable to occur when molding smooth brass patterns, and is caused by a shifting of the sand on the face of the pattern after it has been tucked, and before the final ramming. Thus, two impressions are produced, giving a double outline to each line and curve, making them blurred and ragged. This is sometimes very serious, as the fact that the mold has been *rammed away* cannot be ascertained until after the pattern has been withdrawn. When it is found that a mold has *rammed away* it is advisable to shake it out.

Ramming away can be largely avoided by judicious ramming. In the case of flat patterns, the sand should be first rammed around the sides of the flask. It should be firmly rammed and hilled from the pattern to the flask. Then the face of the pattern should be cleaned off, parting dusted on, and facing is applied with a fine sieve. This is followed by sand riddled through a coarser sieve to a depth of at least one inch. Then the sand can be tucked with the hands, but it should not be patted down. The hilled sand around the sides of the flask will prevent *ramming away*. On raised parts of the pattern, the same procedure can be adopted, and if the sides of the pattern are ornamental a layer of sifted facing should be pressed against them, backed by heap sand, until the sides are rammed up to the face of the pattern, after which the mold is completed in a manner similar to that practiced in molding the flat pattern.

Flasks With Removable Sides

It is sometimes possible to mold square newel posts, having ornamented sides, in a flask with removable sides. The sides of the flask are usually hinged and can be let down after the cope has been taken off, the action being similar to rolling off a cope. In some cases the pattern can be solid, that is, its sides are not loose; in other cases, the sides of the pattern are loose and are left in the mold after the main pattern has been withdrawn, and are rolled to a horizontal position when the sides of the flask are let down. This flask arrangement gives free access to all parts of the mold, and the sides can be finished to the same extent as either the cope or drag It has one objectionable feature, and that is that great care is necessary to avoid a run-out at the juncture of the sides and bottom Therefore, it is sometimes a good plan to ram a curbing around the mold. Small ornamental posts are frequently made by the use of cores on the sides to produce the curved surfaces, and smooth castings can be obtained by using a facing on the core, composed of fine molding sand bonded with molasses, glue or oil.

Supporting Heavy Cores

When making large tubular and other hollow castings, in which heavy cores must be used, the cores should be supported independently of the sand prints of the patterns, otherwise they are liable to crush down. As such castings are usually thin, it frequently happens that the core touches the mold in the drag and the metal is shut off, producing a hole in the casting. It is necessary, therefore, that the sand should be relieved of the weight of the core, and this is

sometimes attempted by ramming blocks of wood in the mold, which rest at one end on the core print, and are sometimes made sufficiently long to reach the bottom board. This method is unsatisfactory, as it often fails to accomplish its purpose. The better method is to have bars in both the cope and the drag flasks. The bars should preferably be of metal, and should be cut out to fit snugly around the core print about half way from the end of the pattern and the end of the print. The part of the bar that embraces the core should be flared out on either side to provide a wide bearing and to avoid all possibility of the upper edge of the bar sinking into the core, thereby allowing it to drop and shut off the metal. It is good practice to ram a bearing of metal in the core at those parts of the prints that will have a bearing on the bars, so that metal surfaces will come into contact and the core will be held firmly in its place. Extra long core prints should be fitted to all patterns similar to those under discussion, not only to provide a solid bearing, but to allow space for a gate between the core supporting bar and the metal thickness. Castings of this type are usually gated on the ends, the sprues being located on the joint of the mold at opposite sides of the prints.

Pouring Large, Thin Castings

A large, thin casting will have to be poured with four pots or ladles, and it is always better to gate on the ends, in preference to the sides of the casting, when this can be done. When end gates are used, a channel is cut in the sand of the core print so as to entirely encircle it, both in the cope and the drag, and from this channel the connecting gates are cut into the mold. When poured, the metal drops down the sprue to the joint of the mold and flows into the channel in the drag under the core. It fills the channel and part of the sprue, so that the molten metal is under a pressure which forces it through all the gates in the bottom of the mold under the core. The casting is thus run from the bottom, and when the metal in the mold has risen to the joint, it commences to climb the core, filling the mold as it rises. On the highest point of the casting it will be found to be good practice to take off vents which should be about the thickness of a lead pencil, and should pass entirely through the cope, in order to prevent any air compression in the upper part of the mold, which might hold back the metal. Many features must be carefully considered when molding work of this character and it is highly important that the flasks be strong and in good condition. When the joint is burnt away it is difficult to obtain good castings, as the danger of a run-out is imminent. If this is guarded against by *rubbing-in* the joint, there is still danger of crushing the mold when clamping-up, as the introduction of wedges into the joint cannot be depended upon to prevent this. The joint of the mold or flask should be solid and a metal flask is always best, because if the joints of the flasks are in contact when the cope is rammed, there can be no crush when the clamps are adjusted on the flask.

BRASS FOUNDRY DIFFICULTIES

Solved by Experts

Filling Shrink-Holes in Cast Aluminum

Will you kindly furnish us with the formula for an alloy, solder, or filling that will positively adhere to aluminum castings, for the purpose of filling shrink spots or holes in the same. Also give directions as to the manner in which it should be used.

This is a case in which prevention is much to be preferred to cure. The use of chills, and the proper adjustment of the gates and feeders can be relied upon to overcome all shrinkage difficulties that may be encountered in making any properly designed aluminum casting. It is possible, of course, to so design a pattern that it cannot be cast, either in aluminum or any other metal. We suggest a careful perusal of the article on the use of green sand cores in aluminum work, which appeared on page 141 of the April, 1912, issue of THE FOUNDRY, because it illustrates the manner in which chills are used in making aluminum castings.

In the early days of aluminum castings, before methods of controling shrinkage were discovered, holes were frequently plugged with an amalgam, of tin or any white alloy. An alloy that might be found suitable is made as follows: Cadmium, 3 ounces; tin, 4 ounces; bismuth, 15 ounces; lead, 8 ounces. Melt in a ladle, stir well and add 2 ounces of mercury. Pour into ingots. This alloy can be softened by heat until plastic, when it can be forced into the shrink holes, and the excess removed when hard. Aluminum solders can also be obtained, and the holes can be soldered up.

Aluminum Propeller Blades

We would like to have your opinion as to the advisability of using aluminum for propeller blades.

We do not recommend the use of aluminum for casting propeller blades, as in our opinion it is not sufficiently strong. We suggest that you use an alloy of copper, 55 pounds; zinc, 36 pounds; tin, 1 pound, and aluminum 2 ounces, for this purpose.

Solid Castings from Scrap

How can I make solid brass castings from scrap? I am not interested in metal mixtures, having nothing to mix, but am trying to make rod brasses and bushings out of old junk, with indifferent success, as the castings when turned are filled with holes. There is nothing unusual about our methods of molding or the sand, and we can assure you that any suggestions that you may be able to offer, will be highly appreciated.

We suggest the use of phosphor-copper, added to the metal just before pouring in the following manner. Melt the scrap under a cover of charcoal, or add several pieces of hard wood with the first charge of cold metal to the crucible. Melt down the entire charge of metal, and get it hot. Remove the pot from the furnace and skim, and right at this point a shrewd guess can be made as to whether the castings are going to be spongy or sound. If the metal is clear and limpid, under its cover of dross and charcoal, it is in pretty good shape, and 1 per cent of

30 per cent of phosphor-copper is all we advise should be used. The phosphor-copper should be in powdered form, obtained by pounding up the brittle mixture of phosphorus and copper. Weigh out the correct amount and scatter a little on the skimmed surface of the metal, then stir well to bring up the dross, skim, and repeat the operation until all the phosphor-copper has been added when the metal should be given a final stirring, and will be found at about the correct temperature for pouring, if it was hot when pulled out. If a layer of pasty metal is found on top of the metal when it is being skimmed, the castings will certainly be spongy if poured while it is in that condition. In this case do not skim but scatter a good handful of phosphor-copper on to the metal, and work it well in to the mush, adding at the same time a little powdered charcoal.

It may be necessary to repeat this operation several times in order to reduce the mush to the metallic state. Then stir thoroughly and add sufficient phosphor-copper to bring the total up to 3 per cent, then stir and pour. It would be better to pour the metal into ingots instead of castings, and then remelt with plenty of charcoal. Before the scrap is used it should be graded, an operation that requires a sixth sense, that is only aquired by experience and observation, therefore, we are unable to tell how to do this, as there is no royal road by which the information can be obtained. For a guide it may be mentioned, that if the metal smokes excessively, when removed from the furnace, it contains too much zinc for rod brasses, and it will be well to cull out the yellow brass before using the metal. It ought to be easy to detect the yellow brass. More of this metal can be used in the bushing castings than in the rod brasses, particularly if the latter are heavy. The presence of zinc, however, will not cause spongy castings, and if there is no choice but to use the yellow brass, the phosphorus can be added just the same, with advantage, only use more of it, as scrap metals high in zinc, and heavily phosphorized, have proved their worth as a metal for heavy castings in the days before it became unfashionable to use phosphorus and zinc together in the same alloy.

Casting Aluminum in Iron Molds

Kindly let me know through the columns of your publication whether aluminum can be cast in iron molds. We have tried to cast a spool, but cannot keep the head from cracking from the spindle.

Owing to its high shrinkage aluminum is not adapted for casting in permanent molds, as it pulls apart. Some simple forms are cast in iron molds, but such a thing as a spool would be very difficult if not impossible, on account of the wide spread of the flanges, which retard the contraction of the spindle to the point of rupture. If the mold was collapsible, the castings could possibly be made after much experimenting to ascertain the most suitable alloy, the proper pouring temperature of the metal and the mold, and the moment after casting at which the mold could be collapsed, and have the casting retain its shape. Taking all things into consideration, it will be more economical to abandon the attempt to cast the spools in metal molds, and adopt the ordinary methods of sand molding.

Discoloration of Brass Castings

We have recently begun making red brass castings for electric brush holders, and our practice has been to use ingot of the following analysis: Copper, 85 per cent; tin, 5 per cent; lead, 5 per cent, and zinc, 5 per cent. We find that this metal is extremely hard on our milling cutters and drills, and we have also had the castings come out of the sand black in color instead of red. Our practice has been to put the castings in a rumbler to clean off the sand, and we wish to learn if it is possible to have these castings come out a nice red color, after they are rumbled, or if it will be necessary to subject them to a chemical bath, in order to obtain the desired color. If the chemical bath is a necessity, please advise what chemicals should be used, and the proportions of each that will be required in making the solution. We have an iron foundry and have been using the same sand for molding the brass castings, that we use for iron, and we thought that it was this practice that caused the brass castings to come out black. We note that in a recent issue of THE FOUNDRY *you advise that under no circumstances should iron skimmers or stirrers be used. This has been our practice and we have discontinued the same. Can you suggest a skimmer or stirring rod that will not be harmful to the metal?*

Surface discoloration of brass castings may be caused by the use of sand previously used for iron, and it will be advisable, therefore, to form a new sand pile for brass molding. The sand may be the same as is used on the bench floors for iron, but it should be new, and devoted exclusively to brass. If occasional brass molding only is done, the sand should be kept in a regular brass molder's tub, and after the work is finished for the time being, the sand should be tempered and sieved, and piled in one end of the tub, patted down with a shovel, and thoroughly wetted. Every few days a little water should be sprinkled over the sand to keep it in shape. In this way the sand is always ready for use, and is kept in condition, whereas if it is allowed to dry out during the intervals that it lies idle, much tedious and laborious work is required to get it tempered again.

Another cause of dirty-looking brass castings is found in the extravagant use of rosin. This material will produce a very unsightly discoloration of the surface of the castings, the cause of which is very difficult to trace. It is better to use it in admixture with charcoal and then not in excess. Its presence in the sand pile may be suspected if an abnormal amount of smoke arises when the castings are poured. The remedy is to add to the molding sand about one-half of new sand or to use some other parting material, and to accept castings of undesirable color with the best grace possible, until the excess rosin has been burned out of the sand pile. In your case, however, the trouble lies deeper. The new sand pile and the discoloration due to the excessive use of rosin are merely mentioned, because it will be necessary to use the one, and not abuse the other, in order to obtain castings of good color. The mixture you are using is eminently suited for making brush holders, as it should have an excellent color and be very easy to machine on account of its lead content. In fact this is a much better mixture than is usually used for making brush holders. It is known as ounce metal. The machining difficulties are caused by the presence of iron. The ingot has been made from scrap, as ingot usually is, but it has not been properly refined. We suggest that you have the ingot analyzed, with particular reference to the iron content, and if further shipments of metal from this source continue to be unsatisfactory, it would be better to obtain the ingot from some reputable maker who will guarantee the analysis to be as desired and free from iron. It will not be at all necessary to dip the castings, as they should leave the sand red in color and clean. The use of an iron skimmer will have no effect on the color of the metal in this case, neither will an iron stirrer, unless it is allowed to remain in the metal sufficiently long to melt away.

Chemical Laboratory of a Large Steel Foundry

Description of the Equipment and Arrangement of the New Laboratory Installed by the Commonwealth Steel Co.

THE Commonwealth Steel Co., Granite City, Ill., manufacturer of open-hearth steel castings, has installed a chemical laboratory, plan of which is shown in Fig. 3. It consists of a main room, 30 feet long and 19 feet wide, with a balance room and office immediately adjacent, each being 10 x 15 feet in dimensions.

The hood, which is in the center of the main laboratory, is divided by a partition into two compartments and is 8 x 5 feet in size over all. This gives a working space on the table of approximately 38 square feet.

It is constructed of wood, properly lined and leads to a flue. It has been found to be satisfactory in operation and keeps the room free from fumes. The work benches are placed against the walls along each side of the room, as shown in Fig. 3. Two sinks are provided, one in a corner of the room and the other at one end of the hood. A still for preparing distilled water has been installed.

The equipment is ample and standard in almost every respect. One of the most modern features is the employment of electricity wherever possible for the generation of heat. A drying oven heated by incandescent electric lamps is used and the temperature control of this device is almost perfect. A small Hoskins electric furnace is provided for igniting precipitates and for other similar purposes. An electrolytic outfit for determining copper, tin, etc., in various alloys, is used. For fuel testing work, a Parr calorimeter of modern type, ignited by electricity, is employed. The balance room includes one Troemner and two Beckers' Sons metallurgical balances and a high-speed motor-driven drill press. In this laboratory the routine work in connection with the operation of the testing of miscellaneous materials is performed, together with a considerable amount of research work in the qualities of cast steel. Every carload of material received, such as pig iron, limestone, ferro-alloys, etc., is analyzed and nothing is unloaded unless the analysis is according to specifications. In analyzing pig iron one sample is taken from each of ten different pigs located at different points in the car. Chunks containing about 64 cubic inches are knocked off from the ten pigs selected for sampling and about 2.5 grams of metal are drilled from each fragment, making a sample weighing about 25 grams. This is ground and mixed in a mortar until it reaches the proper fineness and is thoroughly incorporated, when it is divided and tested in the usual manner. Generally, only one determination is made, it not being necessary as a rule to run duplicate tests. Similar meth-

FIG. 2—A CORNER IN THE BALANCE ROOM

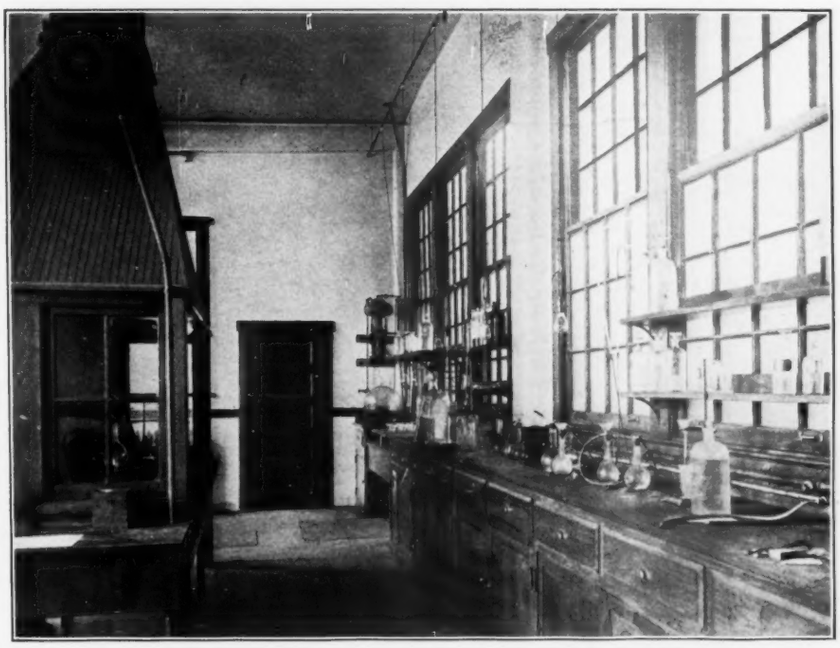


FIG. 1—A VIEW IN THE MAIN LABORATORY, SHOWING THE HOOD

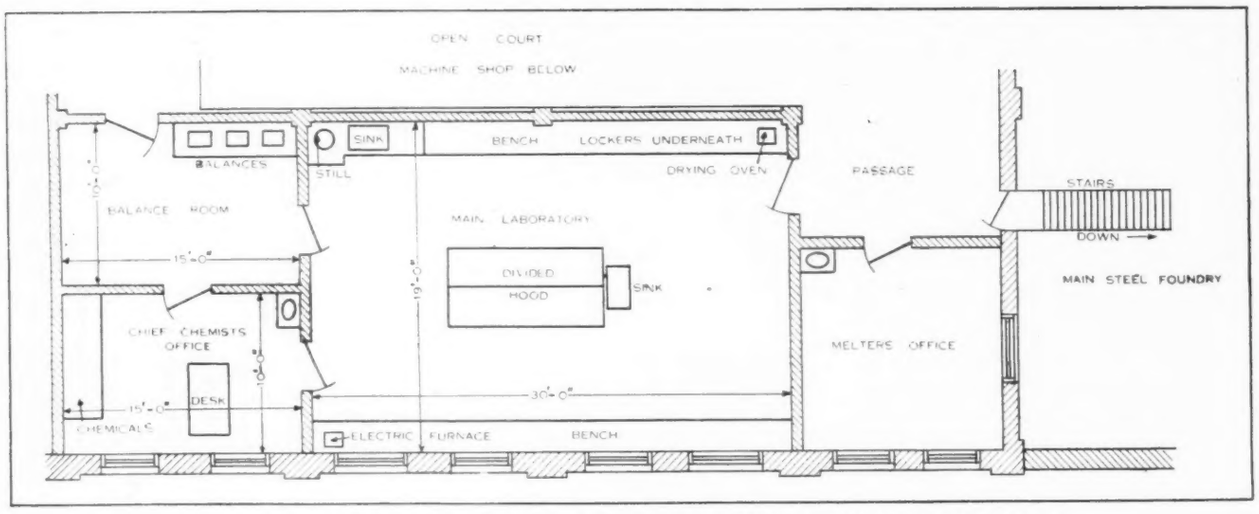


FIG. 3—PLAN OF THE COMMONWEALTH STEEL CO.'S CHEMICAL LABORATORY

ods are used in sampling other materials so as to get a representative sample.

While the heats are being melted and refined in the open-hearth furnaces the usual preliminary tests for phosphorus and carbon are made, using the rapid centrifugal method for the phosphorus determination and the color test for carbon. The finished steel is subjected to three analytical tests, one sample being taken from the first metal poured, another at the middle of the heat and a third from the metal going into the last casting. The samples for the first two tests are obtained in a test spoon and that for the final determination is drilled from a sprue taken from the casting. By this method of sampling the composition of the metal is ascertained definitely.

Test bars, which are turned to the standard size in the machine shop, are made from each heat and are subjected to the usual physical tests for tensile strength, elasticity, reduction of area and elongation. Occasional bending and torsion tests are also made. The details of each heat are reported on a standard form, Fig. 5, which provide columns for the furnace number, heat number, name of melter and constituents of the steel, including carbon, phosphorus, sulphur, manganese and silicon. The physical qualities of the steel are reported on another form, Fig. 6, which also includes a summary of the analyses. For reporting the composition of miscellaneous material, such as iron ore, ferro-alloys, lime, etc., another form, Fig. 4, is used. A form is also used for reporting oil tests, which gives the temperature of the fuel oil and its specific gravity as it exists in each car arriving at the works, together with the corrected specific gravity at standard temperature of 60 degrees, Fahr., and the quantity of oil in the car. The laboratory also periodically makes briquette tensile tests to determine bonding strengths of clays, core compounds, flour, glutrin, molasses, etc., and also makes cement tensile tests as required by the progress of any

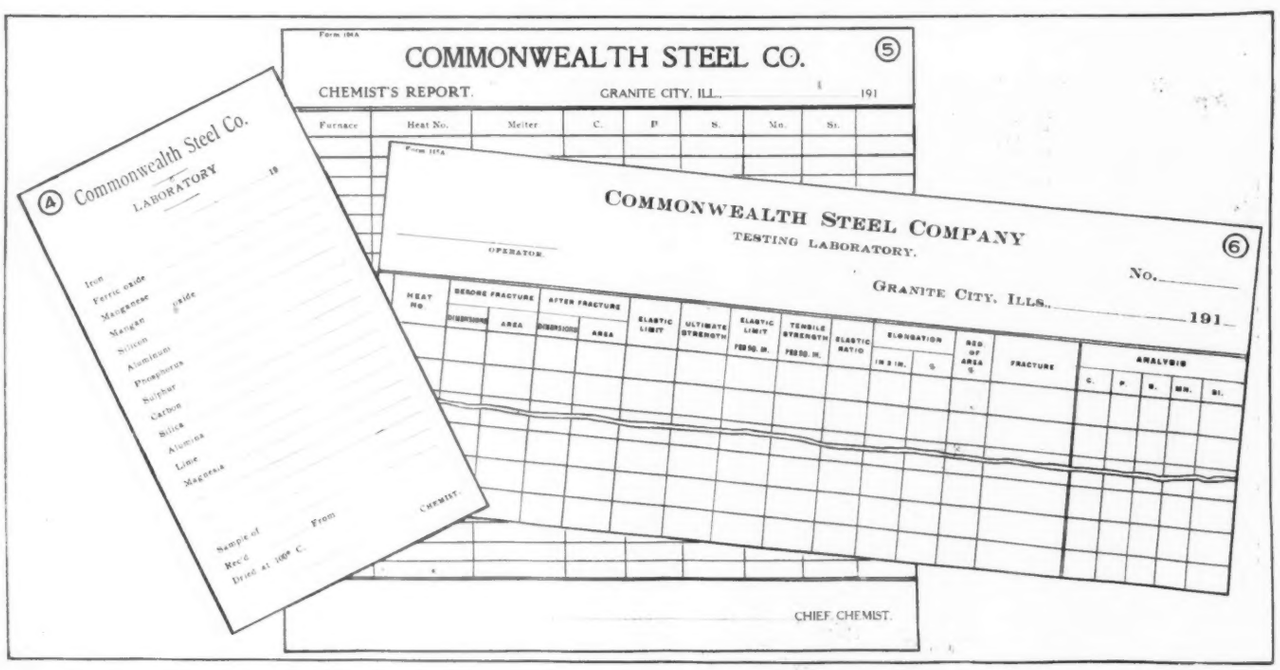


FIG. 4—GENERAL LABORATORY REPORT FORM

FIG. 6—PHYSICAL LABORATORY REPORT FORM

FIG. 5—CHEMIST'S REPORT FORM

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

FORMULAS FOR FINDING THE WEIGHTS OF IRON CASTINGS

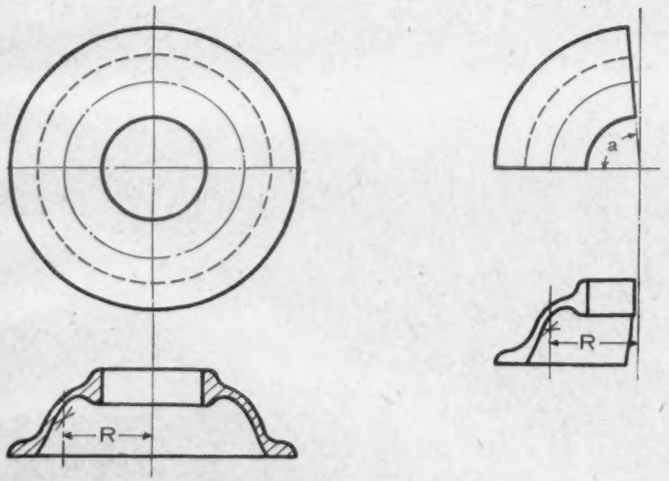
By W. L. Tryon

To find the weight of a solid generated by revolving a plane area about an axis, multiply the area by the distance from the center of gravity of cross-section to the axis by 1.636.

$$W = A\,R \times 1.636$$

To find the weight of a segment of a solid generated by revolving a plane area about an axis, multiply the area by the distance from the center of gravity of cross-section to axis by the number of degrees in the angle by 0.00454.

$$W = A\,R\,a \times 0.00454$$



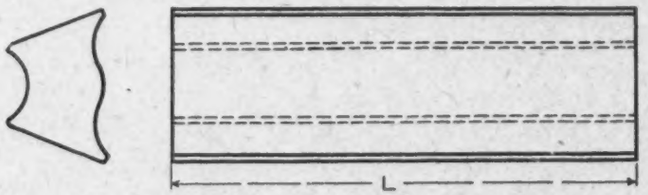
W = Weight of casting in pounds.
A = Area of revolving section in square inches.
R = Distance from center of gravity of section to axis in inches.
a = Number of degrees in the angle.

FORMULAS FOR FINDING THE WEIGHTS OF IRON CASTINGS

By W. L. Tryon

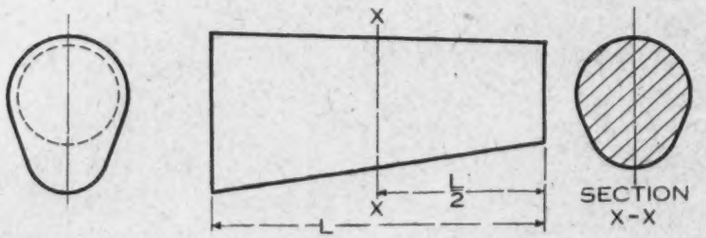
To find the weight of a bar of irregular cross-section, multiply the area of the cross-section by the length by 0.26.

$$W = A\,L \times 0.26$$



To find the weight of a prismoid, or solid generated by a straight line moving over the boundaries of two parallel ends, multiply the sum of the area of the large end, four times the area of the mid-section and the area of the small end by the length by 0.0435.

$$W = (A + 4\,M + E)\,L \times 0.0435$$



W = Weight of casting in pounds.
L = Length of casting in inches.
A = Area of end or cross-section of bar or area of large end of prismoid in square inches.
M = Area of mid-section of prismoid in square inches.
E = Area of small end of prismoid in square inches.

construction work. A Riehle, 100,000-pound tensile testing machine, a Fairbanks cement testing machine and an American gage testing machine are part of the equipment for physical testing.

A Simple and Efficient Skimming Gate

A skimming gate, as its name implies, is a contrivance intended to skim or hold back any dirt or dross held in suspension by the molten metal, or carried on its surface as it enters the mold, and in the case of some metals, notably iron, is a material aid to the production of clean castings. Many and varied are the devices that have been adopted to skim back the dirt and dross, and one that possesses considerable merit, and is easily applied, consists of a ball fitted with an encircling core print around its largest diameter. The ball is molded with the core print entirely in the drag, and a disc-shaped core is fitted into the print, and divides the ball imprint into two hemispherical cavities, the upper one in the cope being connected by a channel to the pouring gate, and the lower half to a gate leading into the casting. Means of communication between the two halves of the ball are established by one or more holes through the core. When a number of holes are used they are generally individually small, and the core acts as a strainer, screening back the dirt and preventing its egress to the lower half of the ball, and thence into the mold.

Occasionally one large hole is formed in the center of the core, through which the metal must pass before it can reach the mold. The size of the hole is governed by the speed with which the mold should take the metal, the flow being regulated to suit any size of casting, by increasing or decreasing the size of the hole in the core. This hole is not intended to act in the capacity of a strainer, but to afford a means by which the metal can be held back until the gates are filled, and in order to accomplish this, the hole is fitted with a plug which is removed after pouring has commenced. On top of the ball is placed a heavy riser, and down the riser the plug is inserted into the hole in the core, by means of an iron rod eyeletted at the top, to which it is attached. To facilitate the fitting of the plug, the hole is tapered about ½ inch, or it can be countersunk to a half circle, and the plug can be merely a cast iron ball attached to a wrought iron stem. When the mold is poured, the plug is in position in the hole in the core like a valve, and the metal flows from the pouring basin down the runner to the joint of the mold, and along a short connecting gate to the upper half of the ball, which it fills and ascends into the riser on top of the ball. When the riser and pouring head are filled with metal, the plug is lifted out of the hole in the core by means of its projecting stem, and the metal immediately fills the bottom half of the ball, and passes through the gate channels to the mold. It is important that the gate and riser be kept filled with metal after the plug has been removed and the mold begins to take the metal, otherwise the dirt which has been held in the head and upper part of the riser, will be drawn through the hole in the skimming core and will enter the mold. Any number of these ball and plug gates can be used on a mold, and they can be placed to prevent the metal entering through upper gates until the lower ones are filled, as in the case of a deep casting. The pattern is made in the form of a split ball, the two halves of which are located in their proper relation to each other, by means of a tapered boss in the center of one half, which fits into a recess in the other half. Each half of the pattern is fitted with a short gate which extends beyond the core print, and affords easy connection with the mold gates. Each gate runs across the core to the ball, and the one in the drag is carried over the edge of the core print to avoid the necessity of parting down in the cope. Each half of the ball pattern can be freely revolved around the other with the center pin as a pivot, so that it is possible to adjust the gates to form any angle with each other that may be required by the shape of the casting.

In an artistically designed and handsomely illustrated catalog of 40 pages, the Lumen Bearing Co., Buffalo and Toronto, make known the facilities they possess for the production of non-ferrous castings and ingot metals. The illustrations comprise views taken in the foundry, and other departments of the works, and convey a clear idea of their extent and equipment. The plant, which was described in a recent issue of THE FOUNDRY, covers a floor space of 65,113 feet, and is devoted to the manufacture of castings in lumen bronze, manganese bronze, phosphor bronze, yellow brass, red brass, and aluminum.

Thin Chinese Castings

Almost the thinnest castings made are the rice pans of the Chinese. These castings are of considerable diameter and almost as thin as paper, and are cast in molds principally formed of clay which is first well kneaded, roughly shaped and then turned true on a potters' wheel. The pans are cast bottom up with the runner on top, and the clay shapes are faced with a thin layer of fine sand, and, therefore, really correspond to flasks or to the brickwork of a loam mold. The cope is about 1½ inches in thickness, and the drag is somewhat heavier. Both cope and drag are well vented to assist the drying of the clay. The sand veneer is swept on after the clay part of the mold has been thoroughly dried, and is also subjected to the drying process, after which the two parts of the mold are assembled and are luted together, great care being taken to get them centrally adjusted so that the iron will be of equal thickness throughout. The completed mold is then placed in a shallow oven and surrounded with charcoal. The oven is closed with a cover of clay held together with straps and bands of iron. The charcoal is then fired, and the mold is brought to a bright red heat, which burns the clay walls of the mold to the condition of brick.

At the same time the metal is melted in a peculiar shaped cupola, the operation being so timed that the mold and the iron are ready at the same time. The cover is then removed from the oven and the iron is run into the almost white hot hold, after which the cover is again placed on the oven, and the casting is left to anneal in its mold. About two days is required for the oven to cool down, after which the mold is carefully separated and the pan extracted, and the clay part of the mold being uninjured is relined with sand and can be used several times, forming one of the earliest examples of the permanent mold. The runner on the bottom of the pan is carefully sawed off, as owing to the extreme thinness of the castings they are easily broken. Handles are formed by drilling holes and fitting in loops of strap iron.

The thinner the pans may be, the better they are liked by the poorer classes of Chinese as less wood is required to cook their contents, and as wood is expensive this is a desirable economy, and accounts for the extreme thinness of the pans. The secret of making such thin castings is due to the molds being so highly heated. The iron is smelted from native ores by primitive methods.

Building an Intricate Burring Machine Pattern

The Development of the Model in Various Stages of Construction is Illustrated and Described

By Jabez Nall

AN ILLUSTRATION of the working drawing of a somewhat complicated steel casting employed as the carriage of a burring machine is shown in Fig. 1. The casting, as indicated by the drawing, appears to be more difficult to make than it really is; nevertheless, the development of the pattern proved exceedingly interesting. Before a pattern can be successfully made it is necessary that the patternmaker should have a clear conception of the size, shape and appearance of the object, which only can be gained from the drawing, and it is obvious that as few lines as necessary, consistent with clearness, be used to project the object on paper. Additional lines, not absolutely necessary, will confuse the workman and at times will increase the cost of the job.

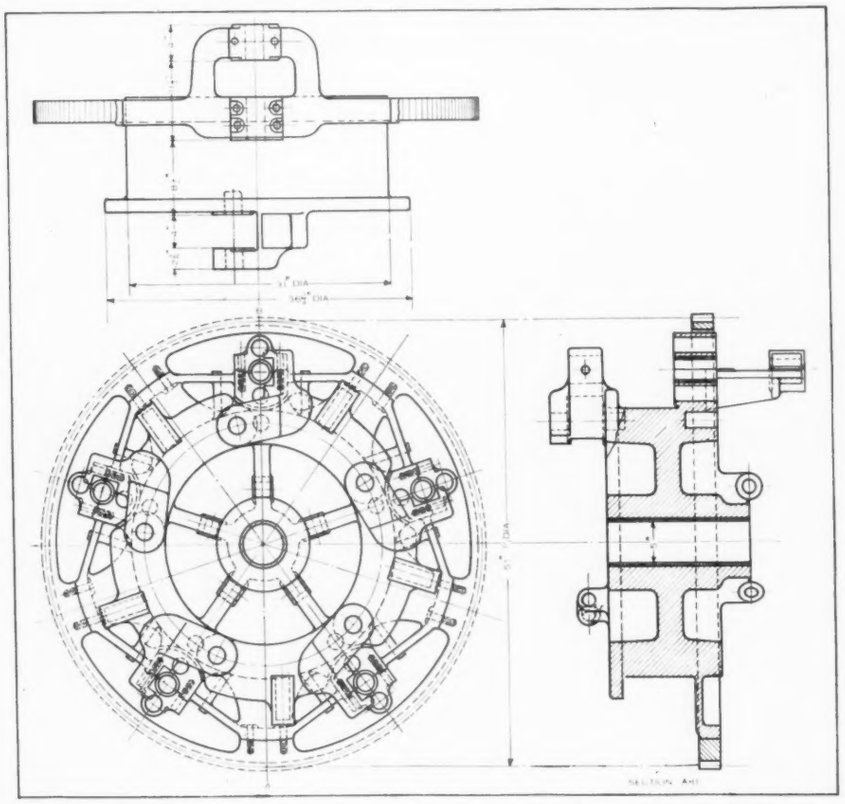


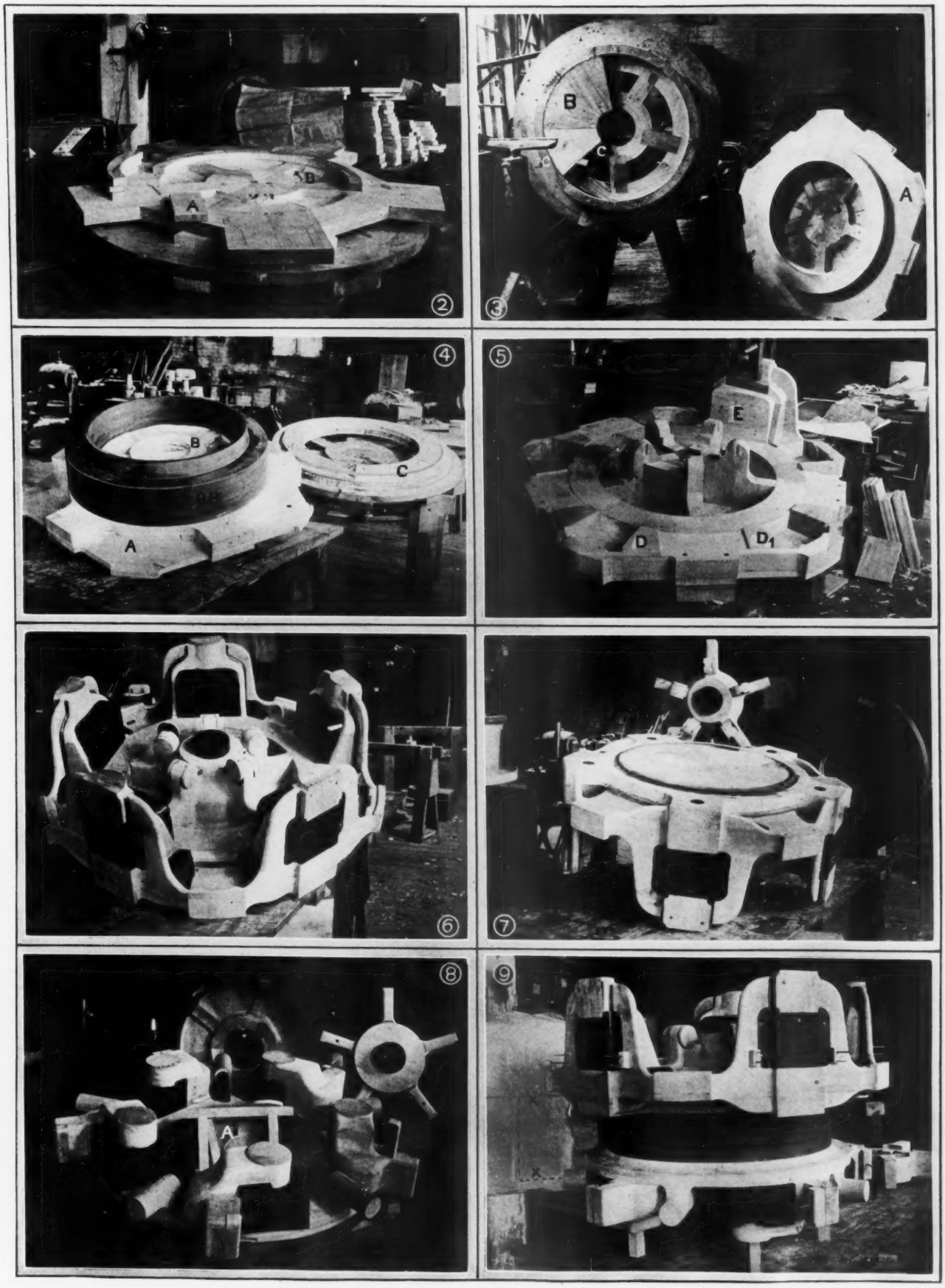
FIG. 1—PLAN, ELEVATION AND SECTIONAL VIEWS OF A BURRING MACHINE CARRIAGE

With reference to the drawing illustrated, little criticism can be offered other than it might be recommended that a foot note under the plan view may have avoided repetition lines of the five duplicate parts shown. The sectional view and the elevation are simple. If all of the lines of the plan had been projected into the elevation, there would have been a confused mass of lines exceedingly difficult to decipher.

The method of molding was the next problem that had to be considered and this included such details as the arrangement of core prints, etc. In this instance it would have been possible to make a two-part mold by adding the core print for the center, as indicated by the lines *XX*, Fig. 9, and by building a core box or core boxes for this part. This, however, was considered objectionable, not only on account of the additional pattern cost involving the construction of a full core box, but if made on a one-fifth section, so many points would have had to be matched on an irregular parting line, that it was considered doubtful whether this could be accomplished even when exercising great care. It was finally decided that the most economical method for both the pattern shop and the foundry, was to make the mold in three parts. This greatly simplified the patternmaking and molding problem.

Constructing the Pattern

After deciding upon the method of molding, the construction of the pattern was next given consideration. To successfully withstand the severe treatment to which it would be subjected in the steel foundry, the pattern had to be made exceedingly strong. The progress of the work is shown consecutively in Figs. 2 to 9, inclusive. The beginning of the patternmaking operation is illustrated in Fig. 2, and in the background is shown the material necessary for carrying on the pattern work to the point illustrated in Fig. 4. The five arms shown in Fig. 2 form the foundation for the subsequent pattern structure. The arms were tongued and grooved at the joints and pieces were inserted between each arm to increase the diameter to a size sufficiently large to carry the ring or body of the pattern. When set, this foundation was attached to the lathe face plate upon which three segments were placed for the pattern to rest on, thereby eliminating the necessity of truing up the entire face plate as well as the back of this part of the pattern, which was secured to the plate by screws from the rear. A fillet, the diameter of the hub, was recessed on the lathe inside of the ring. The centers of the five bearings were next spaced and the outlines were scribed onto the pattern, as shown in the foreground, Fig. 2. The pieces, *A*, were inserted to form the widths of the bottoms of the ribs connecting the center hub to the rim and the return of the fillet around these pieces are shown at *B*. The method of doing this is clearly indicated, as well as the operation of building the first layers of segments, spaces varying from ¼ to ⅜ inch having been left between the inside and outside segmental rows. When this layer was completed and faced off, the pattern was removed from the face plate temporarily to saw out the outline before applying the next row of segments which overhangs, as shown at *A*,



DEVELOPMENT OF THE PATTERN FOR A BURRING MACHINE CARRIAGE, SHOWING THE VARIOUS OPERATIONS IN THEIR PROPER SEQUENCE

Fig. 3. This illustration shows the section of the pattern at the next advanced stage. The lathe work on this pattern, however, in this view has been completed, the back having been trued to size and recessed to receive *B*, Fig. 3.

Building the Web

The method of building part *B* is clearly indicated, but the mode of procedure is practically in the reverse order to the operations pursued in building section *A*. The center web is formed of two layers of ⅞-inch material which gave the required thickness with the grain of the wood running to the center. These two layers rest upon two rows of segments between which are inserted five pieces corresponding with piece *A*, Fig. 2. In building this web, the joints should not be too tight, particularly if the lumber is dry, as this will allow room for expansion. The second layer is laid across joints and is glued slightly at the ends. The outer row of segments is provided for the purpose of eliminating an end grain on the face of the pattern. This outer row is as narrow as possible and a small space is left between the two. A web or flange built in this manner will usually retain its shape under varying conditions of heat or moisture. To bind these parts an inner and outer row of segments overlapping, as indicated at *C*, Fig. 3, was firmly secured with glue and nails. In the outer row, the recessed joint was turned to match with piece *A*, Fig. 3. This section was again rechucked on the face plate and operations were then resumed on the opposite side.

The first operation on the opposite side was to lay off the radial lines as it was found most convenient to do this work on the flat surface. Next, one row of segments was added and the inside diameter was turned to size. This insured the proper amount of draft and the correct size and saved the time of making future measurements. It would have been advisable for the patternmaker to have carved the fillets at this time before building up the ring, *BB*, Fig. 4, to the full height. When this ring was completed, it was found somewhat difficult to carve the fillets, but this was accomplished successfully, although it required considerable extra time. By building this ring to the top, thereby forming a recess for the loose flange, *C*, and by providing a bevel joint, a clean cope lift was insured. Flange *C* is shown at the right of Fig. 4, ready for turning. With the exception of a few minor operations the lathe work on this pattern has now been almost entirely completed.

In Fig. 5 work on part *A* is resumed at the point where it was terminated in Fig. 3. In this view the inside shaft bearings and seats for the revolving gear are built-in, although not finished. The construction is clearly indicated and is practically self-explanatory. The core prints are shown at *E*, *D* and *D1*. The center hub, while built in position, is a separate piece. It was built in place for convenience and to insure accuracy, and while its construction is shown in this view, it is illustrated in its completed form in Fig. 6, and separated in Fig. 7.

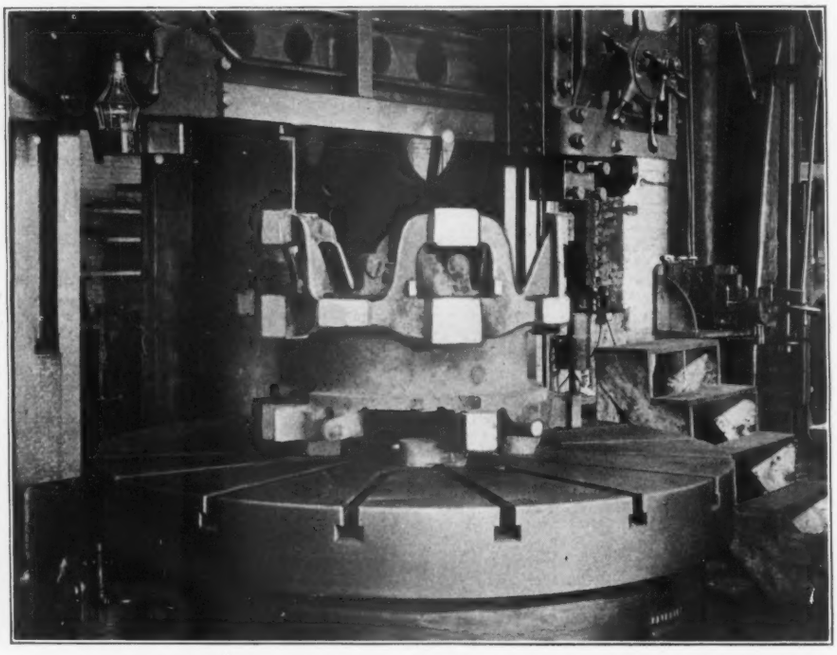


FIG. 10—THE FINISHED STEEL CASTING ON THE TABLE OF A BORING MILL READY FOR THE FINAL MACHINING OPERATIONS

Finishing the Pattern

In the foreground of Fig. 8 is shown pattern *C* of Fig. 4, upon which have been built the brackets and spring boxes. The core box for the brackets, not fully complete, is shown at *A*, while in the rear is shown the cope side of the center or body part of the pattern. The loose cope hub is illustrated at the right. This hub is built-up in a similar form to that of the drag hub shown in Fig. 5, and the reverse side of this is shown at the right, Fig. 9. This view shows the assembled pattern which requires only a few finishing touches.

The four core boxes are exceedingly simple and their shape can readily be determined by the outline of the core prints previously shown. The principal core is the one for the print *E*, Fig. 5, and this was made open at the lower side, a bar across the top carrying the facing for the shaft bearing and a core print for the 1¾-inch round hole. Otherwise, it follows the line of the print shown more clearly in Figs. 6 and 7. The model as made proved the exceedingly practical method of patternmaking adopted and the completed casting is shown on the table of the boring mill in Fig. 10.

Melting Steel in a Brass Furnace

Question:—We desire to make a few small steel castings, and would like to have your opinion as to the feasibility of melting the metal in a forced draft brass melting furnace, also what kind of materials would it be necessary to obtain in order to make the ordinary grade of crucible steel castings?

Answer:—Crucible steel castings are usually made by melting low carbon stock such as boiler punchings and horse nail scrap. The metal is practically wrought iron and exceedingly refractory, and it is not possible to melt such material in a forced draft brass melting furnace, although paradoxical as it may seem, it can be melted in a straight shaft, coke-fired natural draft furnace. The reason for this is that the large volume of cold air that is blown into the forced draft furnace, chills the bottom of the pot, and solidifies the metal just about the time that it has become liquid. At the same time the fire around he upper part of the pot may be burning fiercely, and as a consequence the steel will be melted on top, and solid on the bottom. With a natural draft furnace, properly stoked,

the fire can be kept alive around the base of the crucible, until the metal is thoroughly liquefied and ready for teeming, but with a blower driven furnace this is not possible, no matter whether coal or coke is the fuel used. We doubt whether it will pay you to attempt to make crucible steel castings on a small scale, even if the necessary equipment is installed, as there are so many obstacles in the way of success. It would be necessary to build a new furnace, to learn how to operate it, to make the steel, and to handle it when out of the furnace. In addition the ordinary brass molding methods would not be successful in the case of steel, and therefore, all things considered, it will be much cheaper to purchase the steel castings.

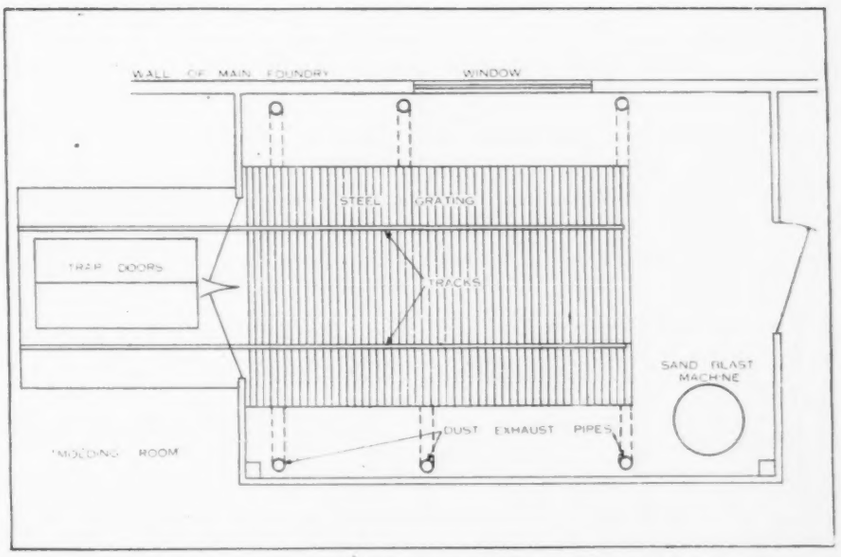


FIG. 2—PLAN VIEW OF THE SAND-BLASTING ROOM

A Model Sand Blasting Room

The principal essentials to be provided for in designing a sand-blasting room are the rapid removal of dust and the proper recovery of the sand used in the operation. The Pawling & Harnischfeger Co., Milwaukee, has recently installed a sand-blasting room in its gray iron foundry which is very completely equipped and possesses a number of features of unusual interest. A general view of this room is shown in Fig. 1 and a plan is presented in Fig. 2. It is situated at one end of the shop, immediately adjacent to the finishing department and is so placed that the material entering and leaving it may be readily handled by the traveling crane. The room is about 12 feet long and 10 feet wide, with a head room of 6 feet. A sand blast machine, furnished by J. C. Busch, Milwaukee, is mounted in one corner, as indicated in the illustrations. One side of the room is provided with a large window giving plenty of light and doors are fitted at each end. An iron grating, as indicated in Fig. 1, comprises most of the floor. The used sand falls into a pit underneath this grating and may be easily removed by opening the trap doors in the platform built at one end of the room. Unusually complete arrangements have been made for the rapid removal of dust. The room is ceiled with galvanized steel sheets which are formed into eight exhaust hoods, as shown in Fig. 1. Each of these hoods is connected by a 4-inch exhaust pipe to the 50-inch, motor-driven fan placed outside. Three 4-inch exhaust pipes are also connected with each side of the pit under the grating. There are, therefore, 14 openings, eight in the ceiling and six in the floor, through which the dust is removed. The exhaust fan is driven by a 15-horsepower, Pawling & Harnischfeger, 220-volt motor running 650 revolutions per minute.

The castings are placed on a truck, *T*, Fig. 1, which runs on a track over the floor grating. This truck is strongly built of structural shapes and has sufficient capacity to handle the largest castings that can be brought into the sand blast room. The platform of the truck on which the castings rest is similar in construction to the grating in the floor of the room, thus permitting the sand to fall through to the pit beneath.

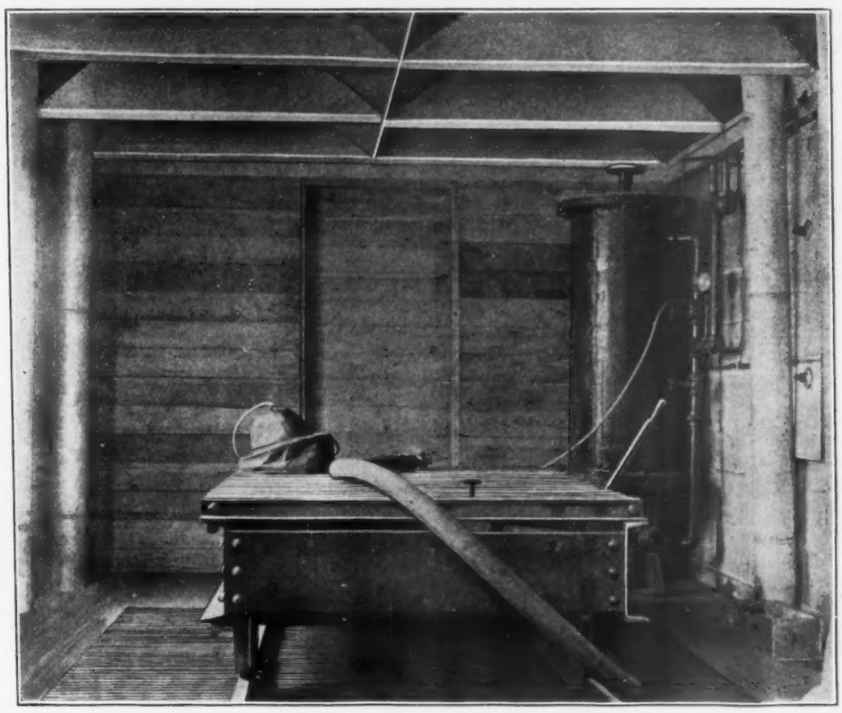


FIG. 1—INTERIOR OF THE SAND-BLASTING ROOM

Excessive Slag in the Cupola

By N. W. Shed

Question.—Our 36-inch cupola is lined to 27 inches and at the present time we are melting low grade scrap which includes grates, stove plate, etc. We have an excessive amount of slag which hardens in the region of the tuyeres and chokes the blast. How much iron should a cupola of this size melt and what size charges would prove most economical?

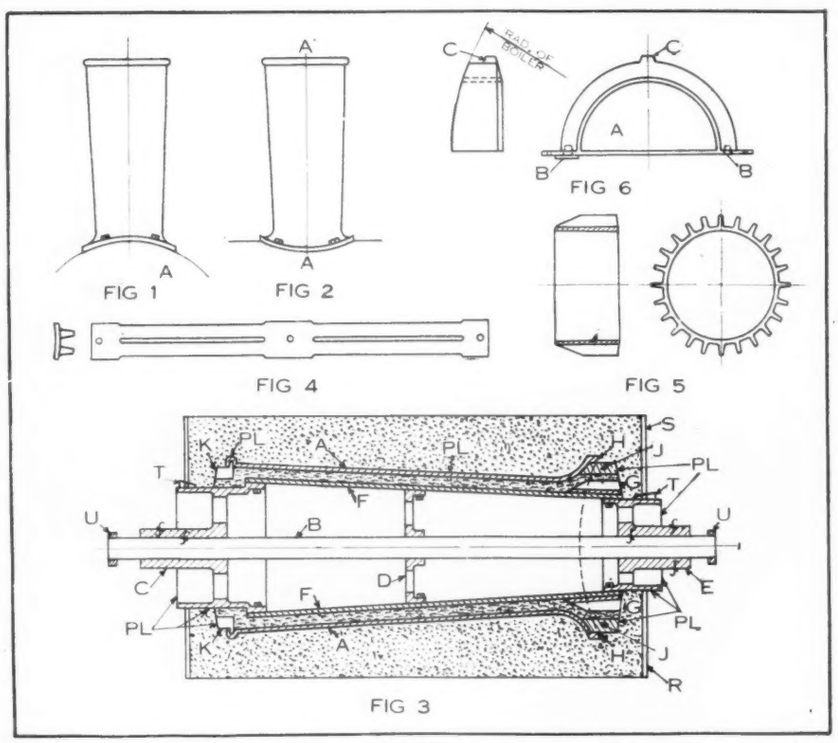
Answer:—The excessive amount of slag is due to the high percentage of

burnt and rusty scrap which you are using. To reduce this slag more coke should be charged and some limestone should be added to make the cinder more fluid. Thirty pounds of limestone to each charge will help you overcome your difficulty. Your cupola should melt more than three tons of iron per hour. The first charge of coke should weigh from 350 to 375 pounds, on top of which 500 pounds of iron should be charged. The succeeding charges should consist of 100 pounds of coke and 500 pounds of iron. You will note that the percentage of coke is high, but a small cupola melting low grade scrap requires more fuel than a larger furnace. The tuyere area also should be large. Six tuyeres, each 4 x 6 inches and 9 or 10 ounces of blast should insure rapid melting. Part of your heavy cinder may be due to a poor grade of coke which has a high percentage of ash. Foundry coke should contain less than 10 per cent ash.

Molding Iron Smoke Stacks

By H N Tuttle

IN THE accompanying illustrations is shown a method of molding cast iron engine stacks by the use of a green sand core, made on an arbor. These stacks form a part of the equipment of traction engines. The principle of using this green sand core, of course, can be applied to other sections of similar form.



DETAILS OF RIGGING AND CROSS-SECTION OF MOLD FOR A CAST IRON TRACTION ENGINE STACK

Front and side views of one of these stacks are shown in Figs. 1 and 2. These are made in sizes up to 20 inches in diameter, 46 inches long and approximately 5/16 inch thick. In Figs. 1 and 2, *A* shows the boiler, to which the stack is attached by four cap screws. A sectional view of the mold with the cores and equipment in position in the flask is shown in Fig. 3. The stack is indicated at *A*. The arbor is mounted on a section of gas pipe, *B*, to which are attached the three rings or heads, *C*, *D* and *E*. Upon the rims of these heads, which are made somewhat similar to a pulley, staves, *F*, are bolted. A detail of one of these stacks is illustrated in Fig. 4. The slots and bolt holes are cast-in, thereby eliminating machine work, as they must occasionally be renewed.

Over the lower end of the arbor another loose arbor ring, *GG*, is slipped, which is illustrated in Fig. 5. This ring is not permanently attached, but is merely slipped over the end of the arbor and is held in position by small, hardwood wedges. This ring carries the sand for the enlarged lower end of the stack," where it is curved, to form a lower flange which fits the boiler shell. It will be noted that this flange is recessed on the boiler side, leaving only a narrow rib, *H*, Fig. 3, which reduces the amount of fitting necessary when erecting the stack and, furthermore, it provides a space for the cement. To form this recess, dry sand cores, *JJ*, are used. These cores are made on cast iron dryers, the one shown in Fig. 6 at *A* being one of the open type. The dowel pin prints on the parting face of the dryer are shown at *B*. One of these makes the pin and the other the hole for properly locking the joint of the cores together when they are placed in the mold. A marker used for locating these cores in the mold is shown at *C*, Fig. 6, but it is not indicated in the cross-section, Fig. 3. A ring core placed at the opposite end of the casting is illustrated at *KK*, Fig. 3. This cores out the groove and the locking device which is provided for holding the spark arrester screen in place.

Making the Core

The hubs, as well as the rims of the heads or pulleys, *C* and *E*, Fig. 3, are machine-finished. When making the core, the hubs, *C* and *E*, form the axle upon which the arbor is turned when the green sand core is being made. After the arbor is clay-washed, it is packed with sand and is struck-off with an iron-faced strike. Stops are fastened to the arbor frame so that the core will be struck-off to the correct size. In Fig. 3, the green sand upon the arbor is shown with shaded lines. It will be noted that at either end the green sand is carried underneath the dry sand cores. This is done to prevent the possibility of the molten iron entering the arbor. The ring core, *K*, is placed over the arbor before the latter is set into the mold, while one of the half cores, *JJ*, Fig. 3, is placed into the mold before setting the arbor in position while the second one is added after the arbor is in place.

The Flask

The pattern line is indicated by *PL*. The pattern is first placed upon a bottom board, after which the drag flask is set in position. The core prints project beyond the ends of the flask. The openings in the flask ends approximately conform to the shape of the pattern, but in order to make the pattern fit perfectly, the molder inserts four small, wooden wedges under the corners of the pattern, which lifts it up against the flask. After the drag has been rammed and when the cope

flask is placed in position, similar wedges are placed between the flask and the pattern, as shown at *T*, Fig. 3. The pattern prints are made the exact size of the rims of the heads, *C* and *E*, so that when the pattern has been removed and the arbor placed in the prints and wedged, it will be conveniently located. The drag flask is indicated at *R* and *S* in the cope. When shaking-out the mold, the arbor is withdrawn from the top of the flask and the loose ring, *G*, slips off and is taken out of the bottom. Steel rings, *U*, are screwed onto the ends of the gas pipe, forming the arbor shaft for convenience in shaking-out the mold. While this method of molding requires considerable rigging, the use of large dry sand cores has been eliminated thus effecting a considerable economy. These stacks are made in this way by one of the largest manufacturers of threshing machines in the country.

THE AMERICAN PLATER

The Electro-Deposition of Brass

By Seymour W Rowsbar

THE average plater regards a brass solution as the one most difficult to manage and many are inclined to avoid its use, although the progressive plater finds the solution a most interesting one. We admit that a brass solution requires more or less constant attention, but if the solution is studied and the various results of certain conditions are known, the difficulties resolve themselves into merely doing the right thing at the proper time. Until recently nearly all brass baths were operated with brass anodes. A great many platers will use no other today and are satisfied that they are getting the best possible results in the most economical manner. It is comparatively easy to deposit brass, but the trouble begins when the same shade of color is required repeatedly. The plater, who is satisfied to be able to deposit brass regardless of color, will never become an adept in this particular line.

Two Commercial Shades

Whether brass or copper anodes are employed, there are two shades of brass recognized by the trade. For all commercial purposes the yellow shade is required, while the green shade is used upon goods of the art metal class and is acknowledged the most beautiful of the two shades. The shade of a brass deposit may be changed to suit the requirements of the operator by increasing or decreasing the amount of zinc and by properly regulating the electric current. The amount of free cyanide, and the temperature and density of the solution also must be considered.

One of the first points we wish to impress upon platers seeking knowledge of brass baths is the advantage of using plastic carbonate of zinc when preparing or replenishing the solution. The plastic carbonate of zinc is easily dissolved in cyanide, while the dry is very difficult to dissolve and the plater is liable to use a greater quantity of cyanide than necessary, thus introducing into the bath an excess of free cyanide which is the cause of many irregularities. The use of plastic carbonate of zinc will effect a saving in time and money and will help to avoid freaky conditions of the solution. The most successful brass platers use the plastic form of carbonates.

Free Deposition of Brass

It is an acknowledged fact among platers who operate brass baths that the metal deposits more rapidly when the amount of free cyanide is kept as small as possible. Free cyanide is necessary to keep the anodes clean, but an excess is not conducive to the best results. The following formula is excellent, and when used with copper anodes the solution is easily maintained in a normal condition: Cyanide of potassium, 1 pound; plastic carbonate of copper, 6 ounces; plastic carbonate of zinc, 3 ounces; carbonate of soda, 2 ounces, and water, 1 gallon. Dissolve the potassium cyanide in cold water, then add carbonates separately and stir thoroughly after each addition. The copper anodes may be used entirely or in the proportion of 3 of copper and 1 of zinc. Cast zinc should be used. The addition of copper carbonate will seldom be required if copper anodes are used, the copper being drawn direct from the anode to enrich the bath. The use of white stick caustic is advised in preference to ammonia as a brightener and to keep the anodes clean. The potash should be pure and care should be taken to avoid the use of caustic soda; one-half ounce of potash dissolved in a quantity of the solution is used to each gallon. The use of white stick caustic potash will be found equally effective in producing a golden tint to the brass deposit. When used for this purpose, the copper content of the solution must be somewhat greater than when the usual brass color is desired. The potash does not evaporate as readily as the ammonia, therefore, the color of the deposits is not so variable. The use of ammonia may be entirely avoided when using the caustic potash.

When copper anodes are used, the plater does not have to experiment to ascertain the metal required, as zinc is the only metallic salt addition needed. We do not advise the use of bisulphite of soda in a brass solution designed for heavy deposits, as in cyanide copper baths its use is accompanied by many conditions rarely met with if the solution is free from it. It loads the solution with inert salts, and if used continually, produces irregular deposits. If the brass deposit blisters, look into the cleaning operation and if satisfied it has been properly carried out, consider next the current density used; finally, if the fault is in the solution, add more metal or reduce the solution with water. A rough, sandy deposit is evidence of too strong a solution and possibly too strong a current. Frequent scratch-brushing will permit the use of a denser solution and stronger current than would be the case if the deposit were allowed to proceed undisturbed. This solution works splendidly when heated to from 80 to 110 degrees Fahr.; the zinc content natu-

rally must be kept greater at this temperature than when used cold or at the temperature of the room. The use of carbonate of soda improves the conductivity of the solution and reduces the amount of cyanide of potassium required. Its use is especially effective when brass plating cast iron and the quantity used may be increased to 4 ounces to each gallon of solution to prevent blisters. When a brass bath is prepared and arsenic used as a brightener, it is necessary to continue its use and a heavy deposit is practically impossible or at least it is very slowly obtained, as the arsenic has a tendency to hold the metal back. The use of caustic potash does not produce this effect to the same extent. When using the caustic potash and copper anodes in a brass bath the solution will often remain nearly normal through weeks of idleness. The writer has used a bath with exceptionally good results after six weeks disuse without a single addition. The bath was merely well-stirred the night before and electrolyzed an hour or so.

Changing Cyanide Copper to Brass Bath

An ordinary cyanide copper bath may be quickly changed to a brass bath by simply adding carbonate of zinc dissolved in cyanide and working with a moderately strong current for a few hours. In fact, many platers prefer this procedure when making up a new bath. The copper bath is first made and operated until a good copper deposit is obtained; then the zinc is added and the brightener, if desired, For work which requires buffing, the brightener is not required. To produce an extra high finish upon brass plated articles they may be nickel-plated heavy enough to color on a buff and then cleaned and brass-plated in a bath containing the caustic potash; thus a very high luster is obtained at a moderate cost. The bath described may be operated with either 5 or 10 volts; on sheet metal, good results may be obtained with 3 volts, using the solution hot. Solutions contained in very deep tanks are more difficult to manage than those in shallow tanks, at least the average plater finds this to be the case. We are of the opinion, however, that proper consideration to the quantity of the solution would minimize many difficulties.

TROUBLES OF THE ELECTRO-PLATER

Discussed by Practical Men

Military Bronze Finish

We would like to have you publish a formula for producing the military bronze finish on brass.

The military bronze finish is obtained as follows: Either polish or acid-dip the articles and then slightly copper plate in the usual manner, after which immerse in a solution of liver of sulphur, ¼ ounce, and one gallon of cold water until a dark brown oxide is formed; then the article should be dried, lightly scratch-brushed, and covered with a French varnish dip lacquer consisting of varnish, 1 part, and 2 parts of amylacetate and fusel oil equally mixed. After the articles are dry they are lightly painted with a finely powdered red aniline dye dissolved in turpentine with a few drops of copal varnish added. Use a soft camel hair brush and then dry the articles by aid of a gentle heat. When hard, the finish is completed by waxing.

Finishing Aluminum Castings

We have some aluminum castings to prepare for exhibition purposes. When finished they must be clean and free from stains. How can we clean them at a slight expense?

A dead white or matte surface may be obtained on the aluminum castings by dipping them in a hot potash solution for two or three seconds, after which they are rinsed in clean, cold water and immersed in undiluted nitric acid. A momentary immersion should prove sufficient. Try a small casting first. The acid removes the oxide formed by the potash and leaves a clean, white surface free from stains. The castings should then be washed thoroughly in clean, cold water and passed through clean, boiling water and dried without being touched by the hands. Portions may then be polished by protecting the matte finish during the operation.

Flaking of Copper Deposits

I am using copper solution made from copper sulphate and sulphuric acid. The deposit flakes off and is very brittle. How can I improve it?

The solution requires the addition of sulphuric acid. When a sour copper solution is deficient in acid a suboxide of copper is deposited along with the copper and a non-adherent dark brittle deposit is the result. Add 2 ounces of sulphuric acid to each gallon of solution and after obtaining a good deposit, no more acid will be required. The metallic strength should be maintained, however, by the addition of sulphate of copper. An article upon acid copper baths appeared in the April, 1912, issue of THE FOUNDRY.

Sulphide Finish on Steel Plate

Can you advise us what is meant by a sulphide finish on steel or iron plate? How is it prepared and for what purpose is it used? We also would like to know if there is a substitute for this material.

We know of no sulphide finish used direct on iron or steel. These metals are either coppered or brassed, after which they are buffed. The article is then covered with a mixture consisting of a quantity of red sulphide of antimony and liquid ammonia made into a thin paste so as to spread uniformly. This is applied with a brush and is arranged to dry either in the air or by the aid of a heater. When the paste is dried it is removed with a dry, circular tampico brush. The article is then lacquered and may be waxed to improve the finish. This finish is employed on hardware and electrical fixtures as well as for ornamental objects. The red or golden sulphurette of antimony must be used to obtain the best results. It is made by precipitating a solution of antimony chloride by means of hydrogen sulphide gas or it may be purchased, which is preferable. It is a red, finely divided substance. There is no substitute for the red sulphide, but a similar finish may be obtained by the following method: Produce a fine matte or dead surface by sand-blast-

ing, using a satin finish brush or a dead dip and then deposit a heavy black nickel coating. This will be gray and will produce the so-called sulphide finish. The article with its black nickel deposit is dipped into a solution consisting of hyposulphite of soda, 4 ounces; sugar of lead, 4 ounces, and water, 1 gallon. The article will become coated with steel black sulphide of lead. Remove the article and then rinse. The particles of lead sulphide are then removed with a soft brush or swab and after drying, the article is scratch-brushed, after which it is lacquered. This finish is used on cheap watch cases and the color is very pleasing.

Casting Brass Anodes

We desire to know the formula for casting brass anodes for a plating solution. We wish to obtain a good yellow brass.

The brass mixture should consist of 66 per cent copper and 34 per cent zinc. The best metal to be obtained should be used. Some platers prefer a 3 to 1 mixture or 75 per cent copper and 25 per cent zinc, but the 2 to 1 mixture has proven very satisfactory and is the mixture generally used.

Coloring Copper Objects

We would like to color some copper black, olive green and brown. Can you furnish us with information regarding the chemical or acid solution that should be used?

To color copper black, dissolve 2 ounces of potassium sulphurette in 1 gallon of cold water and immerse the article in the solution repeatedly until the desired color is obtained. The addition of ½ ounce of ammonia may be found an advantage on some classes of work. Use the solution cold, when fresh. A weak solution is improved by heating. If too strong, the black will peel or flake off. If used on copper-plated articles, the copper deposit should be quite heavy or the oxidizing solution will remove it. The finish may be scratch-brushed or slightly buffed and should be lacquered.

An olive green on copper is obtained by slightly oxidizing the article in the above solution and then immersing it in the following mixture: Copper nitrate, 5 ounces; ammonium chloride 5 ounces; calcium chloride, 5 ounces, and water, 1 gallon. Allow the article to dry without rinsing and then lacquer, after which it may be waxed if desired.

Rich shades of brown on copper or copper-plated surfaces may be obtained by using sulphide of barium, the method employed being the same as when using the potassium sulphurette for black on copper. When using either of the above formulas the article must be perfectly clean, the cleaning process being the same as for plating. Avoid handling the articles before or during the process of coloring.

French Gray Finish

We desire details of the method most extensively employed for producing the French gray finish on silver.

Fully 75 per cent of the work done in French gray is accomplished by the liver of sulphur process. The solution is easily prepared and the results are very satisfactory. Platinum is used for flat ware, etc., where a more durable black is required, but it is quite expensive; various dips containing arsenic also are used. One of the best of these dips is composed of the following: White arsenic, 2 pounds; copper sulphate, 8 ounces, and muriatic acid, 1 gallon. The arsenic is dissolved in the muriatic acid by the aid of heat, care being taken to avoid the fumes. After the arsenic is dissolved, add the copper sulphate; then allow the mixture to cool and it is ready for use. Clean the work thoroughly and immerse in the solution; when the desired color is obtained remove, rinse and dry. The required finish is then obtained by using a bristle brush and a cotton flannel buff. This solution produces a finish which is an excellent imitation of the platinum finish and retains its color well.

Gold Bronze Solution

In the March issue of THE FOUNDRY *several gold bronze formulas were published. We have tried the 95 per cent copper sulphate and 5 per cent aluminum sulphate solution without good results. We have worked the bath both hot and cold, immediately after mixing and after standing 24 hours, using both copper and brass anodes. Can you inform us as to the cause of our difficulty?*

Your trouble has been caused by mistaking formulas for making alloys resembling gold, for gold electro-depositing solutions. The formula that was given was for an alloy of 95 per cent copper and 5 per cent of aluminum, produced by melting the metals and alloying them, and had no connection with the electroplating formulas on the same page. No practical solution is known containing copper sulphate and aluminum sulphate in the proportions as given for the alloy. Aluminum sulphate is sometimes added to acid copper baths, for the purpose of correcting irregularities, but does not appreciably change the shade of the deposit. The following method will produce the deposit desired: Dissolve 10 ounces of cyanide of potassium in 1 gallon of cold water and add 5 ounces of plastic carbonate of copper; stir well, and when dissolved, add one ounce of plastic carbonate of zinc, 2 ounces of carbonate of soda, and 1 ounce of bisulphite of soda. This will make a regular bronze solution; to obtain the gold tint, make up the following solution, and keep as a stock solution in bottles: Dissolve 13 ounces of sulphate of iron crystals, 13 ounces of bisulphite of soda, and 6½ ounces of sal-ammoniac in 1 gallon of water, using sufficient cyanide of potassium to produce a clear solution, which should be boiled for ½ hour, after which it is bottled. To one gallon of the regular bronze solution, add from 1 to 1½ ounces of this stock solution. The bronze may be used either hot or cold, with either copper or bronze anodes. If the bath is used hot, from 80 to 110 degrees Fahr., the zinc content may be slightly increased. A bronze electro-deposit is obtained from copper and zinc, sometimes from copper and tin, but never from copper and aluminum.

Nickel Anodes Covered With Slime

We recently noticed that the nickel anodes in our plating tanks were covered with a thick slime. Our plater contends that this does no harm, but we would like to have your opinion on the question.

The accumulation of any foreign substance upon the surface of anodes is not only a hindrance to the passage of the electric current, but an evidence of uncleanliness as well. Non-metallic substances are always poor conductors and the slime is nothing more nor less than the refuse of the solution and should be removed, not only from the anode, but from the solution. Nickel anodes are particularly susceptible to the formation of such slime and solutions are often doped to remedy irregularities when the slime or mud covering the anodes is the direct cause of the trouble. The anodes need not be cleaned more than once in two or three months if the solution is kept properly cleaned and is not allowed to become aged. The cleaning of nickel anodes can be overdone and much metal wasted, but the formation of thick slime on the surface should be avoided, as it certainly retards the passage of the current to a great extent and thus affects the deposit.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry business.

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG. - - - - Prince's Chambers
CHICAGO - - - - - - 1328 Monadnock Block
CINCINNATI - - - - 503 Mercantile Library Bldg.
NEW YORK - - - - - 1115 West Street Bldg.
PITTSBURGH - - - - - - 2148-49 Oliver Bldg.

SUBSCRIPTION

United States and Mexico - - - - - - $1.00 a year
Canada - - - - - - - - $1.50 a year
Great Britain and other Foreign Countries - Eight Shillings
Single Copies - - - - - - - - 15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances etc., must be received on the 10th of the month preceding date of publication.

COPIES PRINTED

This Issue - - - - - - - 11,000

ENTERED AT THE POSTOFFICE AT CLEVELAND AS SECOND CLASS MATTER.

Copyright, 1912, by the Penton Publishing Co.

Contents

LATEST DEVELOPMENT OF THE PERMANENT MOLD 173
CASTING WROUGHT IRON IN CAST IRON 176
MELTING IRON IN A LADLE 177
SUGGESTIONS FOR PREVENTING FOUNDRY ACCIDENTS 178
A TILTING CUPOLA SPOUT 181
MOLDING LARGE CASTINGS IN AN ENGLISH FOUNDRY 182
MOLDING CYLINDERS ON AN ELECTRIC JAR-RAMMER 185
MOLDING ORNAMENTAL BRONZE CASTINGS 187
FILLING SHRINK-HOLES IN CAST ALUMINUM 193
ALUMINUM PROPELLER BLADES 193
SOLID CASTINGS FROM SCRAP 193
CASTING ALUMINUM IN IRON MOLDS 194
DISCOLORATION OF BRASS CASTINGS 194
CHEMICAL LABORATORY OF A LARGE STEEL FOUNDRY 195
A SIMPLE AND EFFICIENT SKIMMING GATE 197
THIN CHINESE CASTINGS 197
BUILDING AN INTRICATE BURRING MACHINE PATTERN 198
MELTING STEEL IN A BRASS FURNACE 200
A MODERN SAND-BLASTING ROOM 201
EXCESSIVE SLAG IN THE CUPOLA 201
MOLDING IRON SMOKE STACKS 202
THE ELECTRO-DEPOSITION OF BRASS 203
TROUBLES OF THE ELECTROPLATER 204
TRADE OUTLOOK 206
QUALITY OF PIG IRON 206
BLAZING THE TRAIL 207
STEEL CASTING OUTPUT IN 1911 207
A NEW FACING FOR MOLDS AND CORES 208
GREEN AND DRY SAND CORES COMPARED 208
THIRTY YEARS IN THE FOUNDRY TRADE 208
AUSTRALIAN REPRESENTATIVE OF THE FOUNDRY 208
ANNUAL MEETING OF CHICAGO FOUNDRYMEN'S CLUB 208
A JAR-RAMMING MACHINE WITH PATTERN DRAWING CYLINDERS 209
PANSON CO.'S EXTENSIONS 210
CUTLER-HAMMER MAGNETIC SEPARATOR 210
A MACHINE FOR HANDLING CORE OVEN CARS 211
A NEW WESTERN ROLL FOUNDRY 211
A NEW MALLEABLE ANNEALING OVEN 212
DEATH OF JOHN C. KNOEPPEL 213
PERSONAL 213
GENERAL INDUSTRIAL NOTES 214

Trade Outlook

AN INCREASED melt is reported by all classes of casting shops and the outlook for continued activity is exceedingly bright. Car buying has resulted in the placing of large tonnages with malleable and steel foundries and gray iron jobbing shops, with few exceptions, have increased their heats. The decline in pig iron stocks, estimated at nearly 1,000,000 tons in the last 60 days, reflects the tremendous increase in iron consumption, and if requirements continue at the present rate until July 1, stocks in furnace yards practically will be depleted. Foundrymen have figured prominently in the pig iron market during the last 30 days and in many instances requirements have been covered through the third quarter. Prices have strengthened materially, although no advances of importance have been recorded. In the leading iron centers No. 2 foundry is quoted as follows: Chicago, northern, $14 to $14.50; Cleveland, local, $13 to $13.50; Pittsburgh, $14.40; Cincinnati, northern, $14.70; Birmingham, $10.50 to $11; Philadelphia, $14.50 to $15; New York, $14.50 to $15, and Buffalo, $13.75 to $14. Quotations on other foundry grades follow: Malleable Bessemer, Pittsburgh, $14.10; basic, Pittsburgh, $14.15, and Philadelphia, $15; Lake Superior charcoal, Chicago, $15.50.

Quality of Pig Iron

TO THE EDITOR:—In the March issue of THE FOUNDRY, page 119, was published a letter by W. H. Wiard, in which my paper on "The Quality of Pig Iron" was rather severely criticized. The question of pig iron differences is something that none of us knows very much about, and hence I have no quarrel with those who look at the matter in a different light from myself. I do, however, object very much to being criticised for what I did not say. Mr. Wiard accuses me, by implication, of wishing to relegate the foundry chemist to the background. The work I have done on "Chemical Standards for Iron Castings" should be sufficient guarantee that I would be the last to deny the utility of mixing by analysis. I do, however, believe that chemical analysis, as ordinarily determined, is not everything, and this Mr. Wiard himself admits. It is, of course, true that the microscope will afford a clue to most otherwise unexplainable differences in properties by showing up differences in structure, but as stated in my paper, this is only pushing the explanation back one step and does not afford much help to the foundryman who is responsible for results. It is also true that the method of operating the cupola is of very great importance, more so probably than any other one factor. Here again, however, it is not the only factor, and in my opinion one cannot take poor material and make first-class castings out of it even with the most scientific melting. For Mr. Wiard's information I may state that I have seen iron made in the same furnace on the same blast running as low as 0.2 per cent silicon and as high as 9.0 per cent silicon with a corresponding variation of other elements. Any furnace can produce any range of silicon and sulphur desired, the phosphorus and manganese depending on the ores available. Those intangible properties or differences in microstructure not depending on analysis are, in my opinion, dependent chiefly on the rate of driving and the hearth temperature of the furnace when the iron is made. Now, it happens,

that both of these factors usually depend chiefly upon the equipment of the furnace plant and the class of ores smelted, and since they remain fairly constant over long periods of time, the properties of the brand also remain fairly constant. Of course, the only way to absolutely insure getting what is wanted would be to keep an inspector at the furnace (and perhaps we may come to this sometime when we know more about these matters), but in the meantime, specification of brands is the only means at hand for supplementing specification of chemical analysis. In a recent lecture by David McLain appears the following statement: "The claims made by eminent authorities that there must be a vast difference in the same brands of pig iron may be easily exploded, not by some mysterious experiment, but by scientific melting and mixing of iron when there is some man in your shop capable of doing so."

Since my name has been used in connection with this quotation, I feel warranted in taking upon myself to reply to this statement. In the first place, I do not know that anyone has claimed just what Mr. McLain says, *i. e.*, that there must be a "vast difference in the *same* brands of pig iron." Probably he intended to say, in "different brands of pig iron." It is true, as I have already stated, that scientific melting and mixing are of the greatest importance, far more so than care in the selection of brands, but I have still to be convinced that it is possible to so melt a poor iron so as to make a good one out of it, provided it is not treated with deoxidizing alloys or melted with steel scrap, both of which may materially change the structure.

JOHN J. PORTER,
University of Cincinnati.

Blazing the Trail

FOR many years foundrymen have sought the indestructible mold for gray iron castings, and for a considerable period it was generally believed that an iron mold offered so many difficulties that it could never be utilized to advantage. The chilling of the casting, its shrinkage and the coring-out of intricate shapes were among a few of the objections raised against the permanent, metal mold, to say nothing about the expansion of the mold itself, which, when heated to a high temperature, it was believed would produce a distorted casting. An indestructible mold, made of a material other than metal, however, was sought, and numerous compounds were experimented with which could be used repeatedly for casting purposes. Numerous trials with various mixtures, however, were not crowned with success. The shrinkage of the iron invariably broke down the molds and so cumbersome were these objects that it would have been impossible to remove the castings before shrinkage set in, even if an effort had been made to do so. One of the first iron molds tried was water-cooled and one of this type is still successfully employed in the manufacture of sash weights. The molds, however, are expensive to build and must be operated in batteries to facilitate the operation of the water-cooling system. The walls of these molds are light and their design incorporates none of the principles which underlies the heavy cast iron mold so successfully used today. When he began the investigation of the possibilities of utilizing cast iron as the material for permanent molds, Edgar Allen Custer was forced to discard the theories of those engaged in early research work along this line and he was compelled to blaze a trail through an entirely unknown field. Every theory advanced was contrary to the practice of the foundryman casting iron in sand and every principle since evolved for permanent mold work reflects the dissimilarity of the two methods of making gray iron castings. A heavy mold, which would not easily become heated and of a thickness many times greater than that of the casting, proved to be the underlying principle of the permanent mold process. Water-cooling was thereby eliminated and the mold heated so slowly that no difficulties were experienced from expansion. The chilling of the castings was a problem not so readily solved, although today any amount of chill desired can be obtained. To the untiring efforts and painstaking investigations of Mr. Custer the casting of gray iron sections in permanent molds has been carried to a successful conclusion. Elsewhere in this issue two machines are described and illustrated which are designed for casting respectively, small projectiles and 36-pound grate bars. Their construction reflects the ingenuity of the designer and indicates in only a small way the large number of intricate castings for which permanent molds can be adapted. Mr. Custer's greatest achievement will be the successful production of standard cast iron car wheels, weighing from 650 to 750 pounds. Two machines equipped with permanent molds for this work already have been built, and late reports from the plants in which they have been installed indicate the feasibility of the undertaking. The next step in the development of this practice involves the casting of steel in metallic molds. It is believed that the rapid chilling of this metal will prove to be a desirable property that will greatly facilitate the solution of this problem. The elimination of blow-holes in steel castings, it is believed, can be achieved by the utilization of the metallic mold for this work and if this is accomplished it will mark the greatest advance yet recorded in steel casting practice.

Steel Casting Output in 1911

NOTWITHSTANDING a decline in the total steel casting production of approximately 30 per cent in 1911, as compared with 1910, the falling off in the output of castings made by the converter process was less than 2 per cent. The greatest decrease was in the tonnage of open-hearth steel castings, whereas the crucible product remained practically stationary. To be exact, the steel casting output last year totalled 646,022 tons, as compared with 940,832 tons in 1911. Of last year's output of steel cast sections, open-hearth steel foundries contributed 571,191 tons, against 863,351 tons in 1910, a decrease of 292,160 tons. Of the total converter production of steel castings in 1911, 3,216 tons were made by the standard Bessemer process, 26,211 tons by the Tropenas process, and 27,669 tons by the Bookwalter and other modifications of the Bessemer process. The total converter steel casting output in 1911 was 57,096 tons, against 58,335 tons in 1910. In 1909, only 33,814 tons of converter castings were made. These statistics reflect the output of the large number of converter installations during the last two years and the growing appreciation of this method of steel production, which can profitably be confined to small heats. Many gray iron shops, to meet a limited local demand for steel castings, recently have installed converters and this practice is growing in all sections of the country.

A New Facing for Molds and Cores

A new protective coating for molds and cores is being introduced to the foundry trade by the Pure Carbon Co., Wellsville, N. Y. It is known by the trade name of the "Slickest Slicker" because of its unctuous and slippery nature, which is one of the most important properties of a material of this kind. In addition to its soft and apparently greasy qualities, the material is well adapted for the purposes for which it is intended, being a very pure form of carbon, closely related to graphite, and takes rank between that substance and the ordinary modifications of carbon, such as coke, coal and charcoal.

Every foundryman appreciates the value of a good facing or blacking for either molds or cores and for this purpose carbonaceous substances have been found to give the best results for iron and for heavy bronze castings and the value of graphite for this purpose is well known. Graphite, however, owing to its cost, has been supplanted wherever possible by less expensive materials which have found a wide field of usefulness. The new material, from a chemical point of view, closely approaches graphite. It is a by-product recovered in the manufacture of electric arc lamp carbons, commutator brushes, etc. These products necessarily must be highly refractory. This material is prepared for foundry use in the form of an impalpable powder and can be furnished in four grades, each adapted for some special purpose and applicable as a wash for dry sand molds or as a dry blacking to be dusted, brushed and slicked on the surface of green sand molds. A special core wash also has been prepared with this material and both as a blacking and a core wash it was thoroughly tested before it was offered to the foundry trade. This material is being used successfully in electrotyping processes and also has been used extensively as a preservative paint for iron and steel.

Green and Dry Sand Cores Compared

"Green and Dry Sand Cores" was the topic discussed at the regular monthly meeting of the Chicago Foundrymen's Club, held at the Great Northern hotel, Chicago, April 13. The trend of thought at the meeting seemed to favor green sand cores when practical. The discussion was led by A. M. Thompson, of H. W. Caldwell & Son Co. Mr. Thompson sketched the development of core-making processes over the past 40 years. In the early days he stated the only core binder known was a clay wash and weights were sometimes placed over the pouring gates to create sufficient pressure in the fluid metal to prevent blow holes.

The defendants of the dry sand cores contended that they were more uniform, safer to use and in sizes that can be conveniently handled on a bench. The advocates of green sand contended that their method required less floor space and no expense for transporting cores between the core room and molding floor. It was also claimed that green sand cores being more elastic, there was less loss due to shrinkage cracks and that the metal flows better over green sand. In the course of the discussion the troubles of the core room foreman were fully explained. In one case it was stated a batch of cores fell apart immediately after they were withdrawn from the oven. The cause of the trouble was discovered with considerable difficulty, but when located proved to be absurdly simple. The coremaker had used lime instead of flour in his binder.

J. S. HIBBS

Beginning with its June issue, *The Merry Molder*, published by the Osborn Mfg. Co., Cleveland, will award each month a prize of $10 in cash for the best paper on foundry practice written for this publication. The contest is open to all shop readers of *The Merry Molder*, including superintendents, foremen, molders and laborers. The paper must discuss some example of improved foundry practice in which the improvement has been accomplished by an Osborn machine or accessory.

Thirty Years in the Foundry Trade

On April 1, J. S. Hibbs, assistant general manager of the J. W. Paxson Co., Philadelphia, rounded out 20 years of service in the employ of that company. Practically 30 years have elapsed since Mr. Hibbs first engaged in the foundry supply business, having built the plant of the Chicago Foundry Supply Co., Chicago, which nearly a quarter of a century ago was absorbed by the S. Obermayer Co., Cincinnati, known at that time as the S. Obermayer Foundry Supply Mfg. Co. Mr. Hibbs was general manager of the Obermayer Chicago branch until he became affiliated with the Paxson company. His wide experience in the foundry supply trade, both in the east and central west, has given Mr. Hibbs a wide acquaintance among foundrymen and he is anxious to hear from his former personal friends, who, he suggests, should address him at 3203 Columbia avenue, Philadelphia.

Australian Representative of the Foundry

J. F. Buchanan, Australian representative of THE FOUNDRY, who has been associated with Mort's Dock & Engineering Co., Ltd., Sydney, N. S. W., Australia, for 11 years, severed his connection with that concern on April 1 to assume the position of foundry superintendent of Taylor's Paragon Foundry, at Sydney. Mr. Buchanan, whose home address is 28 Rowntree street, Balmain, Sydney, N. S. W., as usual will be pleased to answer all inquiries from Australian subscribers to THE FOUNDRY pertaining to any subject, whether relating to the purchase of equipment, discussions of practical problems, subscriptions, etc.

Annual Meeting of Chicago Foundrymen's Club

The annual meeting of the Chicago Foundrymen's Club will be held on May 25, and it has been proposed, although not definitely decided, that the members of this organization visit the Gary plant of the United States Steel Corporation during the day, returning in the evening for the banquet, which has been one of the enjoyable features of the annual meetings of this club for many years.

J. F. Buchanan, 28 Rowntree street, Balmain, Sydney, N. S. W., superintendent of Taylor's Paragon Foundry, would like to obtain catalogs and price lists of all kinds of foundry equipment from American manufacturers.

Equipment for the Foundry and Pattern Shop

Jar-Ramming Machines With Pattern-Drawing Cylinders—Magnetic Separator—Annealing Furnace

THE Tabor shockless jar-ramming molding machine, equipped with two pattern-drawing cylinders, is illustrated in Fig. 1. This machine is of the standard type equipped with a 10-inch jarring cylinder and is provided with a table, 42 x 54 inches. To the machine has been added a base which carries two pattern-drawing cylinders, each 6 inches in diameter and having a 36-inch stroke. The pattern-drawing plungers are coupled together by means of a squaring shaft mounted in bearings on the base and attached to the pattern-drawing frame carried by the plungers, thus insuring security of movement. The pattern-drawing plungers are operated by compressed air on oil, which is contained in the oil tank shown at the front of the machine.

The speed of the stroke can be varied at will by the operator and the pattern-drawing frame may be stopped at any point desired during either its upward or downward movement. The machine can be used either with stripping plates or it can be arranged for rolling over the mold. When using stripping plates, a lug on the stripping plate engages with the pattern-drawing frame in its upward movement, thereby lifting the stripping plate and flask, leaving the pattern on the jarring machine table. When used as a roll-over, I-beams are thrown across the pattern-drawing frame to engage with the trunnions on the flask and the flask is rolled on its trunnions when the plungers have reached the top of their stroke. After the flask has been rolled over, it is returned to the jarring table and bedded, then unclamped and the pattern drawn. The I-beams are placed on the pattern-drawing frame in a position to engage with lugs on the pattern board. The machine shown in Fig. 1 has capacity for handling molds up to 3,000 pounds in weight with 80 pounds air pressure at the machine, due allowance being made for speed of operation.

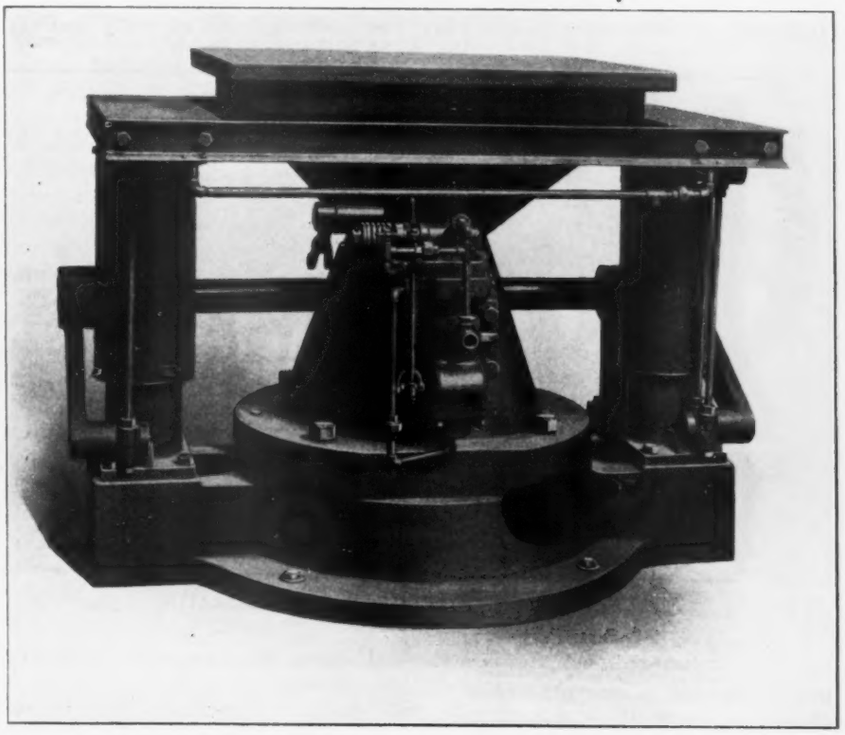


FIG. 2—PLAIN JARRING MACHINE EQUIPPED WITH TWO PATTERN-DRAWING CYLINDERS

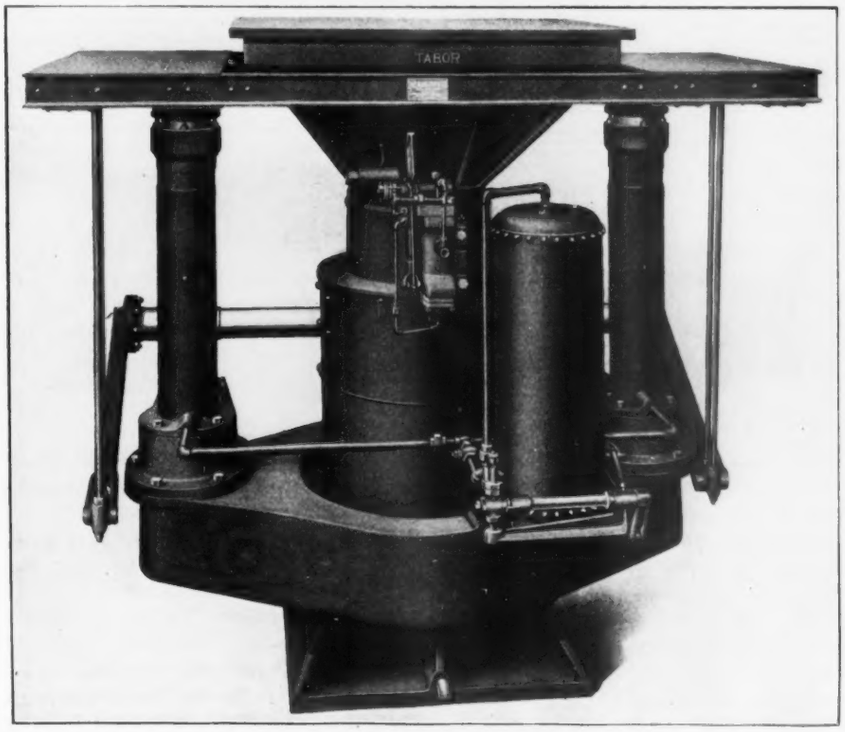


FIG. 1—SHOCKLESS JARRING MACHINE EQUIPPED WITH TWO PATTERN-DRAWING CYLINDERS

In Fig. 2 is shown a 6-inch plain jarring machine arranged similar to the shockless machine shown in Fig. 1. These molding machines are built by the Tabor Mfg. Co., Philadelphia.

Paxson Co.'s Extensions

The plant of the J. W. Paxson Co., Philadelphia, manufacturer of foundry facing, supplies and equipment, has been greatly extended by the erection of a new two-story, saw-tooth roof building, which is 90 x 120 feet. The additional manufacturing space thus provided is utilized by the departments engaged in the production of sieves, wire brushes, bristle brushes, bellows and wire cloth. The demand for these products has increased so rapidly in recent years that an increase in the output became essential. A large amount of new machinery also has been installed, which was especially designed and built for the particular requirements of these various departments.

The unusual facilities of the J. W. Paxson Co., not only as manufacturers, but as constructing and equipment engineers, is indicated by the fact that the new building was designed and built entirely by the company's employes. The site was laid out by the company's surveyors and all of the structural steel, concrete and carpenter work was done by gangs of workmen from various departments of the J. W. Paxson Co. An electric lighting and power plant also has been added and all of the machinery throughout the plant is now driven by individual motors.

A well-equipped chemical laboratory also has been added and greatly increases the company's facilities for making analyses for all of its raw materials, thereby insuring an absolutely pure and unadulterated product for the consumer. Careful analyses are made of all Paxson standard facings and, in addition, this department permits of the manufacture of any special facing desired by foundrymen. All of the molding sands shipped by the company are carefully analyzed and every effort is made to furnish the foundrymen with the best possible available product. The Paxson company has greatly added to its acreage of Albany molding sands, a number of large farms having been purchased during the past few years.

The stock department of a foundry supply house, owing to the varied line of product which is handled, requires careful attention to insure a constant supply of all materials to meet the demands for prompt shipments. The Paxson company has installed an efficient stock-keeping system in which more than 1,500 items are listed. The stockkeeper makes a daily report of the goods on hand and in this way the depletion of stocks of any materials is entirely obviated.

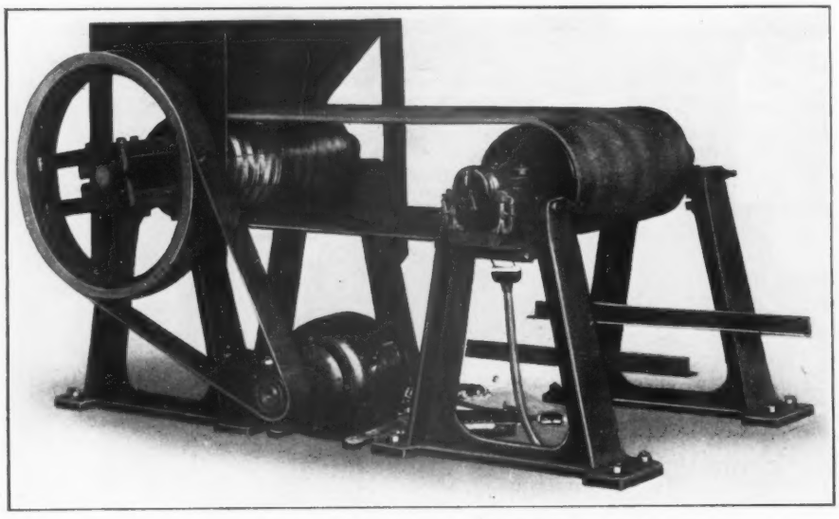


FIG. 1—CUTLER-HAMMER MAGNETIC SEPARATOR

Cutler-Hammer Magnetic Separator

The use of magnetic separators in foundries for removing small particles of iron, steel, shot, gaggers, etc., from molding sand is increasing rapidly. For this purpose the Cutler-Hammer Mfg. Co., Milwaukee, has recently perfected a magnetic separating outfit, the details of which are shown in the accompanying illustrations. In either case the pulley at the right-hand end acts as a magnet. It consists of alternating coils of wire and steel discs, the coils being wound on steel spools doweled to the discs, which are in turn keyed to the pulley shaft. Each coil is enclosed and protected by a cylindrical brass shield. Direct current for energizing the coil is transmitted by means of a pair of brushes resting on slip rings situated at the end of the magnetic pulley shaft.

The magnetic pulleys are built to a standard diameter of 12 inches and in lengths varying from 16 to 36 inches. In foundries which have a comparatively small amount of material for separation, the 16-inch pulley is usually sufficiently large. Any iron particles in the sand on the belt cling to the magnetic pulley and the separation is thus effected. Where the sand is hot a fireproof conveyor belt is used and asbestos covered wire is employed for the construction of the magnetic pulley coils.

When installed, the material is fed by means of a chute or other arrangement onto the belt, which carries it over the magnetized pulley. The capacities of these separators vary from 1,340 to 3,000 cubic feet of sand per hour.

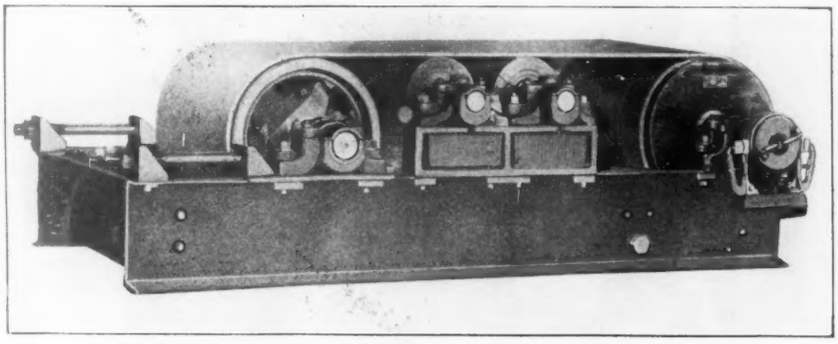


FIG. 2—MAGNETIC SEPARATOR WITH I-BEAM MOUNTING

The Doehler Die-Casting Co., Brooklyn, N. Y., has established an office in the Ford building, Detroit, which is under the direction of H. B. Griffin, vice president of the company.

A Machine for Handling Core Oven Cars

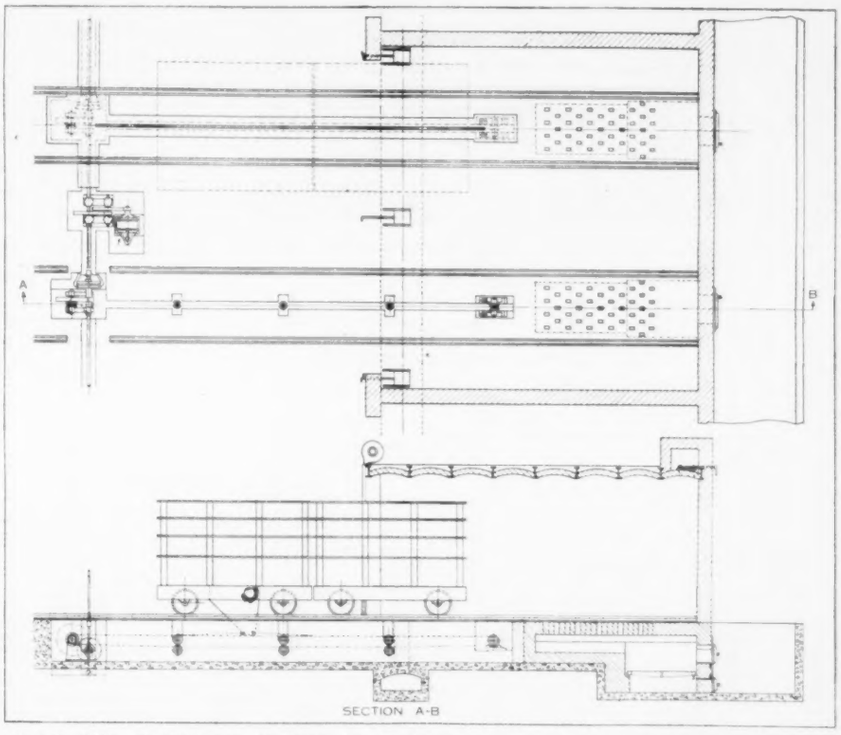
In nearly every foundry the difficulties and expense involved in hauling loaded core trucks in and out of the ovens is a problem not easily solved. The larger the core oven the more difficult the problem becomes. In some foundries a gang of men is employed to move the trucks by hand. The more general practice in large shops is to use a chain fastened to the hoist of the traveling crane; the chain passes over a pulley placed in the floor in front of the oven, one end being fastened to the core car and the other to the hook of the crane hoist. This method of hauling oven cars, although an improvement over hand labor, is slow and cumbersome at the best. The crane can only handle one oven at a time and considerable time is wasted in shifting the tackle; also if the head room is low, the crank hook in some cases cannot be hoisted high enough to do the work satisfactorily. The greatest objection to this method, however, is that it ties up the crane and takes it from other work, usually at a time when it is most needed. In a large foundry the demands on the traveling crane are incessant, and if it is used for hauling core oven cars in addition to its other work, serious delays in molding operations are often of frequent occurrence.

To relieve the traveling crane of this work and provide a more satisfactory method of handling core oven cars, the Whiting Foundry Equipment Co., Harvey, Ill., has devised the apparatus illustrated herewith.

It consists of an endless haulage chain passing over a sprocket mounted on a line shaft, which is driven by a reversing motor. The chain lies in a concrete-lined pit or slot in the center of the track and runs over a series of idlers. In large ovens, as shown in the illustration, there are two cars on each track; a plate riveted to the frame of the outer car extends down into the pit and is connected with the chain, thus transmitting the motion to the cars. When connected in this manner the chain does not extend more than half way under the oven floor, leaving plenty of room at the rear for the fire box.

A 10-horsepower, reversing motor is used, connected to the line shaft through two spur gear reductions. The chain sprocket is mounted on a sleeve running loose over the shaft and is connected thereto by a friction clutch acting through a single spur gear reduction. By the use of the clutch any car in a battery may be moved at will. The motor is designed to haul the cars on one track at a time and there is generally one motor for every four tracks. The hauling speed is approximately 25 feet per minute. Fifteen-ton loads can be handled.

Fourteen of these hauling machines have been recently installed by the General Electric Co., there being eight at the Pittsfield, Mass., plant, and six at the Erie, Pa., foundry. The accompanying illustration also shows an improved core oven designed by the Whiting Foundry Equipment Co. This oven is planned to occupy a minimum floor space for a given capacity and to have a uniform and even heat distribution. The roof consists of a series of short transverse fire brick arches supported by heavy I-beams instead of the single large arch that is often employed.



PLAN AND SECTIONAL VIEWS OF MACHINE FOR HAULING CORE OVEN CARS

At the annual meeting of the stockholders of the Joseph Dixon Crucible Co., Jersey City, N. J., the retiring board of directors, consisting of Geo. T. Smith, Wm. Murray, Edward L. Young, Wm. H. Corbin, Geo. E. Long, Wm. G. Bumsted and Harry Dailey were unanimously re-elected. Officers for the ensuing year were chosen as follows: Geo. T. Smith, president; W. H. Corbin, vice president; Geo. E. Long, treasurer; Harry Dailey, secretary, and J. H. Schermerhorn, assistant treasurer and secretary.

A New Western Roll Foundry

The Hubbard Steel Foundry Co. will erect a large addition to its plant at East Chicago, Ind., which will be devoted exclusively to the manufacture of sand and chill rolls, as well as other rolling mill equipment. This will be the first roll foundry in the west with the exception of the shop operated by the United States Steel Corporation in the Chicago district. The addition to the Hubbard plant will be 160 x 165 feet. The shop will be laid out in three sections, the middle bay being 75 feet wide with a crane runway extending its entire length. The height of the runway to the top of the rails will be 30 feet and this middle section will be served by a 40-ton crane. In the north bay, which will be 30 feet wide, two 20-ton air furnaces of the Swindell type will be installed. The south bay will be 60 feet wide and will be served by a 10-ton crane. The scrap yard, which will parallel the furnace bay, will be 59 feet wide and will be served by a 10-ton gantry crane.

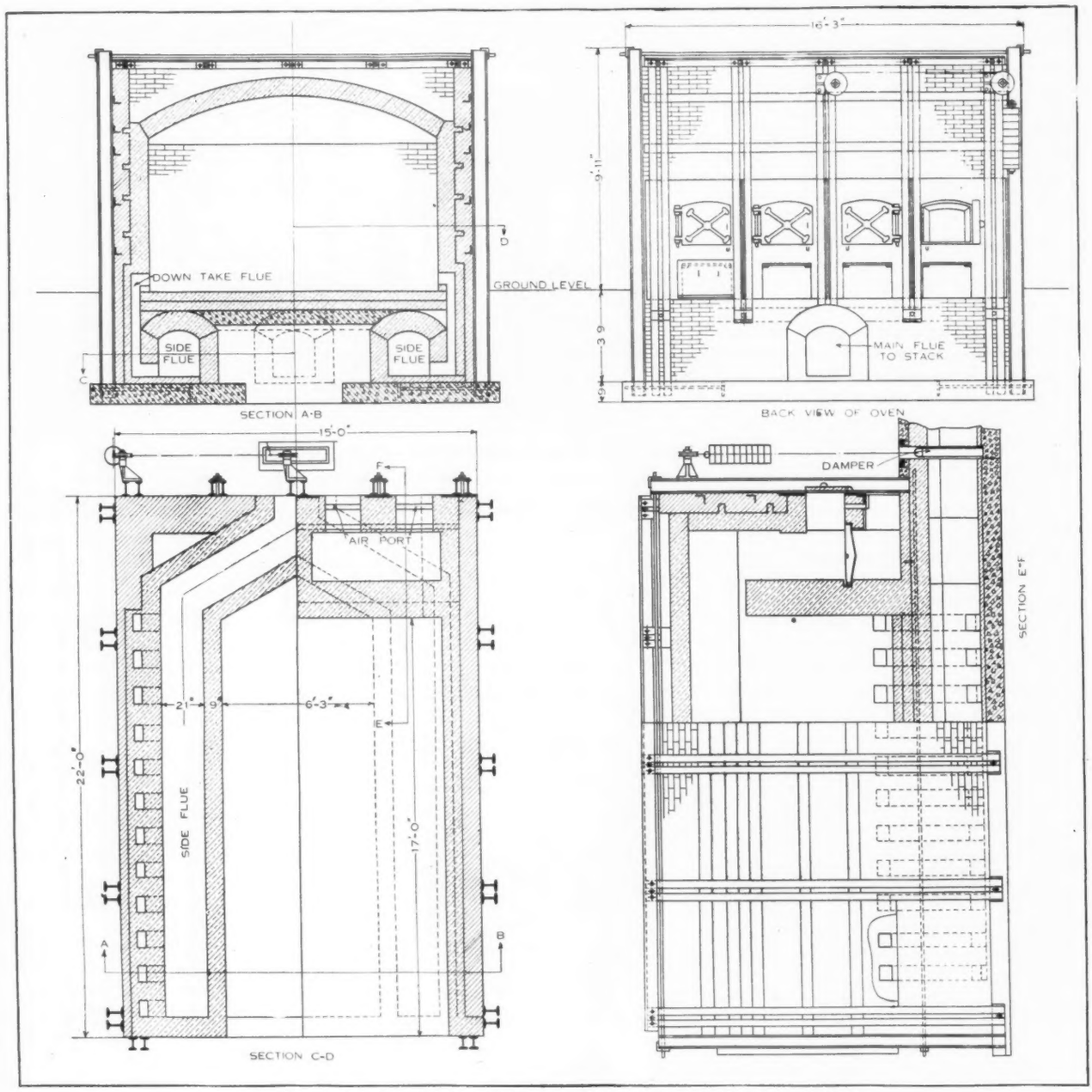
A machine shop, 75 x 120 feet, also will be erected and all of the machine tool equipment installed in the present plant will be moved into the new shop and a large number of new tools also will be purchased. The Hubbard Steel Foundry Co. is in the market for five roll lathes, an 8-foot vertical boring mill, a 5-foot horizontal spin-

dle mill, an 8-foot planer, a gear planer capable of turning out spur gears up to 20 feet in diameter and bevel gears up to 14 feet in diameter, as well as a complete list of smaller tools including lathes, drilling machines, planers, etc. Another 150-kilowatt generating set will be added to the power plant equipment.

The new buildings will be of steel construction throughout, equipped with metal sash and every effort will be made to place the additions in operation no later than July 1. Chas. J. Mesta, president and manager of the Hubbard Steel Foundry Co., has had a wide experience in the manufacture of all kinds of rolling mill equipment.

A New Malleable Annealing Oven

The accompanying illustration shows the construction of an annealing oven with a new style of flue arrangement, which has recently been designed by the Whiting Foundry Equipment Co., Harvey, Ill. The older type of oven, from which this was developed, had a large number of take-off flues of small size under the floor, and in order to clean them it was generally necessary to remove the floor of the oven bodily. In the new design there are only two large side flues, 21 inches square, situated as shown in the accompanying illustration. These have fire brick arched roofs, which make their maximum height 22½ inches. The side flues communicate at the rear with the main chimney flue and receive the burned gases from the floor of the oven through a series of down-take flues placed in the wall. The grate, which has an area of 10 square feet, is at the rear, the flame and hot gases entering the annealing chamber over a bridge wall situated immediately in front of the grate. The distance from the top of the wall to the top of the grates is 4 feet 1½ inches, while that from the top of the wall to the highest point in the arch of the furnace roof is 24 inches, the bridge wall itself being 18 inches thick. This flue arrangement is exceedingly simple and is said to be unusually efficient. An oven of this type was tested in service and six pyrometers



SECTIONAL AND PLAN VIEWS OF MALLEABLE ANNEALING OVEN

placed at various points showed a variation of only 50 degrees Fahr. Since the temperature within the oven ranges from 1,250 degrees to about 2,000 degrees Fahr., the negligible effect of so slight a variation in temperature as that given above will be appreciated. The side flues under the floor are easily accessible and may be readily cleaned.

In addition to its flue arrangement this oven has several other improved features. The roof is a single transverse fire brick arch and in order to prevent the sides from bulging, due to the influences of heat, five brace walls are built across the roof. The binding is extra heavy, consisting of 6-inch I-beams placed in pairs completely around the walls. These beams are securely tied together at the top over the brace walls by heavy steel rods.

The fire doors are 17 x 18 inches in size and are made with slots to take up the expansion. The doors have 4½-inch fire brick linings and no metal is exposed to the heat. An air port with an adjustable slide is built in the door sill. This conveys fresh air from the ash pit to the top of the fire.

The oven shown in the accompanying illustrations is 22 feet in length over all, 15 feet wide and 13 feet 8 inches in height. From the ground level to the top of the oven the distance is 9 feet 11 inches. Inside the oven is 16½ feet in length, 12 feet in width and 8 feet in height to the center of the arch. It is completely lined with fire brick, the walls and roof having an average thickness of 9 inches. The side walls are further strengthened by a 9-inch course of common brick, mortised to the fire brick wall.

Death of John C. Knoeppel

John C. Knoeppel, the well-known foundryman and inventor of improved methods of melting iron, died on March 28, of cerebral apoplexy, at the home of his son, C. E. Knoeppel, La Porte, Ind.

Mr. Knoeppel was born in New York City, in 1850, and at the age of 15 began an apprenticeship in the foundry of Barnett & Son Co., Newark, N. J. From that time until his death he was actively engaged in the foundry business. For over 20 years he was employed as a molder, during which time he traveled extensively and worked in many shops, laying the foundation of that extensive knowledge of the foundry business for which he was distinguished.

In 1888 Mr. Knoeppel realized his ambition to rise above the ranks and accepted an appointment as superintendent of the foundry of the Buffalo Forge Co., Buffalo. He held this position for 12 years and then removed to Oswego, N. Y., where he was employed by the Ames Iron Works in a similar capacity. He also served as foundry superintendent for H. A. Carpenter & Son, Providence, R. I., Clark Bros Co., Belmont, N. Y., and the Walker Foundry Co., Erie, Pa.

He retired from active foundry work several years ago to devote his attention to devising better methods for melting iron, with the result that he designed and patented a system which bears his name, the aim of which is the utilization of the waste heat in the furnace. During the last three years Mr. Knoeppel was prominently identified with foundry efficiency work, and with his son, C. E. Knoeppel, installed scientific management systems in the foundries of the Pittsburgh Valve Foundry & Construction Co. and the Jones & Laughlin Steel Co., Pittsburgh, and the M. Rumely Co., La Porte, Ind.

Mr. Knoeppel was a strong advocate of quality molding and fair treatment of his employes. He took a natural pride in having his shop a place where men could work under the best conditions. Although always a firm believer in piecework, he recently became converted to the bonus plan of payment. He is survived by his widow and two sons.

Personal

T. C. Skeen has been appointed vice president of the Continental Radiator & Foundry Co., St. Louis.

E. L. Binns, for six years foreman of the foundry at the Superior division of the American Seeding Machine Co., Springfield, O., has resigned.

G. A. Andresen has been placed in charge of the foundry supply and equipment department of the Chicago Fire Brick Co., Chicago.

At a meeting of the American Society of Mechanical Engineers, held April 30, Rudolph Diesel, inventor of the Diesel engine, was elected to honorary membership.

J. M. Magnuson, formerly general foreman of the Henry E. Pridmore company, Chicago, has been appointed superintendent of the Livermore Foundry & Machine Co., Memphis, Tenn.

Max E. Duncan has severed his connection with the American Car & Foundry Co. and has accepted a similar position with the Canadian Car & Foundry Co., Montreal, Que.

J. E. Fogerty has accepted a position as superintendent of the Nordyke & Marmon Foundry, Indianapolis. Mr. Fogerty was formerly superintendent of the foundry of Giddings & Lewis, Fond du Lac, Wis.

Robert Ardelt Jr., foundry engineer, who has been engaged in the erection and operation of various foundries in Germany during the past 15 years, is now associated with R. Ardelt & Sohne, Eberswalde, Germany.

Geo. Smith, formerly superintendent of the steel foundry department of the Londonderry Iron & Mining Co., Nova Scotia, resigned to accept a position as superintendent of the Dutcher Works of the Prime Steel Co., Milwaukee.

F. J. Patterson has accepted a position as sales agent with the Domhoff & Joyce Co., Cincinnati, pig iron and coke merchants. Mr. Patterson will make his headquarters in Indianapolis.

R. F. Lake has been placed in charge of the laboratory of the Perfection Spring Co., Cleveland. Mr. Lake recently has been engaged in consulting metallurgical work and formerly was steel editor of the *American Machinist*.

B. M. Waldron, Roxbury, Vt., has accepted a position as general foundry superintendent, with the American Engineering Co., Philadelphia, which has been formed by a consolidation of Williamson Bros., Philadelphia, and the American Ship Windlass Co., and the Taylor Underfeed Gravity Stoker Co., of Providence.

Trade Publications

FURNACES.—The W. S. Rockwell Co., 50 Church street, New York City, has recently issued a 48-page bulletin devoted to its line of twin-chamber and double-end, underfired annealing furnaces; single-end annealing and hardening furnaces, carbonizing, rotary annealing, rod heating, forge, tire-heating, tinning pot, and enameling furnaces. Melting furnaces also are shown for aluminum, copper, brass and soft metals. All the furnaces illustrated are arranged for oil or gas.

STEEL PLATE AND VENTILATING FANS.—Two bulletins recently issued by the American Blower Co., Detroit, illustrate and describe steel plate and disc ventilating fans. The steel plate fan is built especially for the movement of air and gases. The fan wheel consists of a central steel shaft on which is keyed a cast iron hub with radiating arms or spiders, which are cast into the hub, forming an integral part therewith, and to which the vanes or blades of the fan are securely riveted.

SEMI-STEEL.—David McLain, director of the Milwaukee Correspondence Schools, Milwaukee, has published a handsomely-illustrated 32-page catalog, devoted to the manufacture of semi-steel by McLain's system. A large number of testimonial letters are included from practical foundrymen who have taken McLain's course and they speak in enthusiastic terms of the benefits derived therefrom. Nor is the work devoted entirely to testimonial letters, but, in addition, views of a large number of semi-steel castings are included, made by students who previously had no knowledge of semi-steel practice.

General Industrial Notes

The Troy Foundry Co., Troy, O., will erect a new foundry, 60 x 128 feet.

The H. J. Frank Foundry Co., Davenport, Ia., contemplates the erection of a two-story brick foundry.

The Gerlinger Steel Casting Co., West Allis, Wis., will erect a $12,000 addition to its foundry.

The Murphy Iron Works, Detroit, will erect a one-story foundry, 80 x 100 feet, also a power house 50 x 75 feet.

The Chattanooga Iron & Wire Works, Chattanooga, Tenn., contemplate the addition of a new plating department.

A new foundry, 41 x 66 feet, is being erected by the Greensburg Foundry & Machine Works, Greensburg, Ind.

Jensen & Muzzy, Payette, Idaho, contemplate the erection of an iron and brass foundry which will be operated in connection with their machine shop.

The Pittsburgh Valve & Fittings Co., Barberton, O., is erecting an addition to its iron foundry, 565 x 165 feet, which will more than double the former output.

The International Hoist Co., Antigo, Wis., will shortly erect two new buildings. The main building will be 40 x 80 feet and the foundry, 60 x 90 feet.

The Titan Steel Castings Co., Newark, N. J., will erect a foundry, 150 x 250 feet, on Lister and Chapel streets. The estimated cost of the new building is $30,000.

The A. E. Shorthill Steel & Iron Works, Marshalltown, Ia., is erecting a new plant at Perry, Ia., to which it will remove as soon as completed.

The American Radiator Co. will erect a 25 x 145-foot addition to its foundry at Litchfield, Ill., and will extend the core room, 36 x 90 feet.

The A. P. Smith Mfg. Co., East Orange, N. J., will erect a one-story steel, concrete and frame addition to its foundry, 90 x 87 feet.

T. R. Littleton & Son, Fredericktown, Mo., will erect a foundry addition to their machine shops on West Main street. The building will be of brick construction, 30 x 65 feet.

The Greenlee Foundry Co., manufacturer of gray iron castings, Chicago, will erect a new foundry and is in the market for cupolas, tumbling mills, a sand blast outfit and other foundry equipment.

The Geo. W. Mason Engineering & Mfg. Co., West Middlesex, Pa., is erecting a new plant at New Wilmington which will be used as a foundry. The old plant will be dismantled.

The J. I. Case Threshing Machine Co., Racine, Wis., contemplates the erection of a new foundry at Lakeside for the manufacture of gas farm tractors and other machinery.

The United States Radiator Corporation will erect a new foundry addition, 135 x 200 feet, to its Edwardsville, Ill., plant. New foundry and core room equipment will be installed.

The A. Y. McDonald Mfg. Co., Dubuque, Ia., manufacturer of plumbers' brass goods, pumps, etc., contemplates the erection of a new plant, 190 x 260 feet, four stories high. A large amount of new equipment will be installed.

The Cape Fear Machine Works, Wilmington, N. C., is erecting a new plant at the foot of Church street, to which it will remove as soon as completed. The new plant includes a machine shop, blacksmith shop, foundry and pattern shop.

The Home Stove Works, Chicago, will erect a new foundry and warehouse. The foundry will be 136 x 166 feet and the warehouse, 92 x 205 feet. Both buildings will be four stories high and will be of fireproof construction.

The Keystone Steel Casting Co., Chester, Pa., has added one 4-ton acid open-hearth furnace, and the plant now has a capacity of 2,400 tons of open-hearth and 375 tons of crucible steel castings. The manufacture of McHaffie castings has been abandoned.

The Price-Evans Foundry Co., Chattanooga, Tenn., contemplates the erection of a large addition to its plant, 90 x 110 feet, for the manufacture of ornamental iron. The new building will be of brick and concrete construction.

The National Aluminum & Bronze Mfg. Co., Indianapolis, Ind., has been incorporated with a capital of $10,000 to do a general foundry and machine shop business. The incorporators are H. J. Weiler, H. Hunt and E. Davis.

The Napanee Iron Works, Ltd., Napanee, Ont., has been formed to take over the business of the Dominion Rock Drill Co. and will erect large new steel and brick buildings. A cupola, ladles, machine shop equipment and other tools will be required.

The Sheeler-Hempsher Co., Philadelphia, will erect extensive additions to its plant, including a 26 x 100-foot addition to the general foundry building and a 26 x 52-foot storage building. Additional machinery will also be purchased.

The Oneida Foundry Co., Inc., Oneida, N. Y., has been incorporated with a capital of $25,000 to engage in the manufacture of metal castings, machinery, etc. The incorporators are H. R. Willis and G. D. Gingrich, Williamsport, Pa., and R. M. Gingrich, Oneida, N. Y.

The Egan-Rogers Steel & Iron Co., 929 Chestnut street, Philadelphia, which is erecting a new steel and iron foundry at Crum Lynne, Pa., will require new equipment, including two cupolas, a one-ton electric hoist, core-making machine, tumbling barrels, emery grinders, hack saw machine, drill press, shaper, sand blast apparatus and general foundry supplies.

The New York Central Iron Works Co., manufacturer of boilers, steam and hot water tanks, etc., has removed its plant from Geneva, N. Y., and is erecting a new plant at Hagerstown, Md. The new building is 80 x 250 feet, of steel construction, and has a separate power house and fan room for heating apparatus. All machinery is electrically-operated.

The Emerson-Brantingham Co., Rockford, Ill., has excavation well under way for its new foundry, which will be 120 x 250 feet. The building will be of standard construction with brick walls and a steel trussed roof and will be fireproof. The foundry will have a capacity of from 50 to 60 tons of castings per day. The product will be used entirely in the farm machinery manufactured by the Emerson-Brantingham Co. In addition to the foundry a two-story cleaning building is under construction. The upper floor of this will be used for the storage of patterns and the lower floor for cleaning castings. This will be a reinforced concrete structure throughout.

Among the Brass Founders

The Union Art Metal Works, Trenton, N. J., have installed a plating plant.

The brass and aluminum foundry of the Sterling Machine & Stamping Co., Wellington, O., recently destroyed by fire, will be rebuilt.

The Cox Brass Mfg. Co., Van Woert street, Albany, N. Y., will erect a two-story addition to its plant, 100 x 35 feet, and will also erect a new foundry at a cost of $10,000.

The Fitzgerald Brass Foundry, Albany, N. Y., manufacturer of locomotive castings, contemplates the erection of an addition to its works that will enable it to manufacture castings for electric purposes.

The Dominion Rock Drill Co., Ltd., Napanee, Ont., manufacturer of gray iron, brass and aluminum castings, has changed its name to the Napanee Iron Works, Ltd., and is erecting a new plant, at an estimated cost of $40,000.

The McRae Brass Mfg. Co., Detroit, has recently been incorporated to take over the business heretofore conducted as a partnership under the name of McRae & Roberts. This concern makes a specialty of steam brass goods.

B. F. Klein, owner of the Gas Fixture & Brass Co., Cleveland, has purchased the plant of the United Brass Mfg. Co., that city, which will continue to be operated under its present name. This plant makes a specialty of plumbers' brass goods.

Bureau Bros., Philadelphia, have sold their bronze foundry at Twenty-first street and Allegheny avenue and are having plans prepared for a new plant, including a foundry, office and other buildings, to be erected at Twenty-third and Westmoreland streets. The new plant will be much larger than that formerly occupied and will be well-equipped throughout.

The Stanley Bronze Co., Bridgeport, Ct., has recently been organized to manufacture brass and bronze castings. A plant has been erected at State and Dewey streets, which is now in operation. W. D. Stanley, formerly with the Bridgeport Brass Co., is one of the incorporators of the new concern.

The new brass foundry being erected by the Fairbanks-Morse Co., Beloit, Wis. is now nearing completion. The new building is of brick and concrete construction, 52 x 140 feet, with saw-tooth roof. Three electric traveling cranes are being installed. This company also contemplates the erection of a 125-foot extension to its iron and steel foundry and an 80 x 130-foot extension to its blacksmith shops.

The United Foundry & Machine Co., Bridgeport, Conn., recently incorporated, will erect a new plant, 100 x 200 feet, on a tract of land bounded by the N. Y., N. H. & H. R. R. R and Connecticut avenue in the east end of Bridgeport. The company will manufacture brass, bronze and aluminum castings. The incorporators are Wm. C. Buckelew and Philip D. Beach, Bridgeport, and Andrew Steen, New York City. Mr. Buckelew was formerly president of the Fairfield Aluminum Foundry Corporation, which was later purchased by the Aluminum Castings Co., of Cleveland.